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PAGE 47



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PAGE 118



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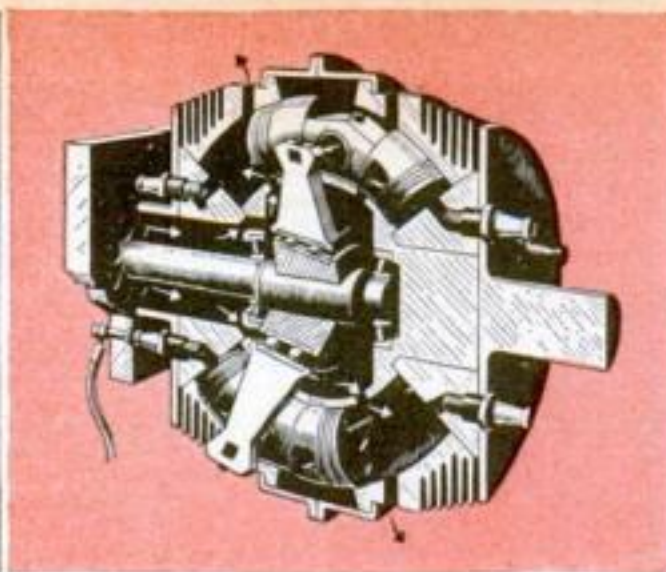
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Spinning engine: *It works like a Dipsy Doodle. P. 51*



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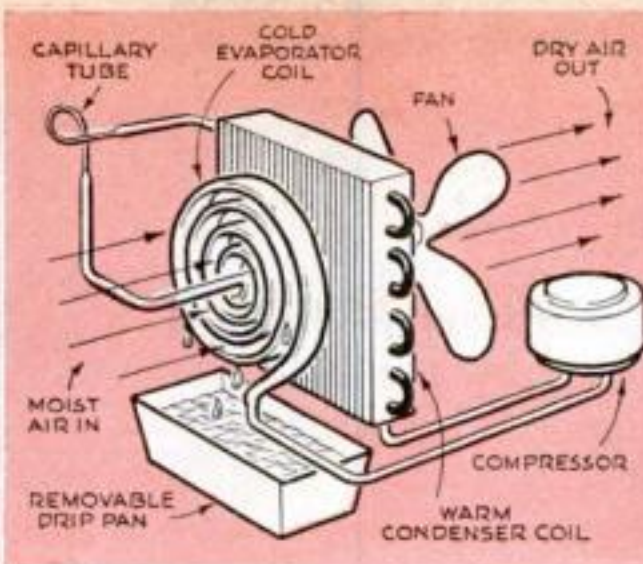
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NEXT MONTH

Who said the Volkswagen would never change? It has, and plenty, reports PS Senior Editor Devon Francis, who drove the new VW 1500 at the factory in Wolfsburg, Germany. It's styled like a Detroit product, scampers from 0 to 60 in 20 seconds, and cruises at 80. Read all about it in September Popular Science.

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PS Readers

TALK BACK



Tips on Towing a Trailer

I'M WITH Oertle ["I Say Trailer Travel Pays Off," June]. We rented a 15-footer last year—it happened to be brand new—and used it for 11 days. My wife and I and four of our children never had so much fun on a vacation.

We bought our V-8 station wagon with the thought that we'd be towing a trailer. It was ordered with heavy-duty springs and shock-type overloads. We ordered standard transmission with overdrive (3.91:1—not 3.3, or such). With this combination you get a higher-ratio rear end, an advantage in towing. We tow with the overdrive locked out.

With a car with an automatic transmission and a high-ratio rear end, your gas mileage when driving without the trailer would be very poor. Mine, with overdrive, is good with or without a trailer; and I mean good. Mr. Oertle mentioned 10 m.p.g. pulling a trailer much the same size as the one we had. On our 2,100-mile trip, we averaged 12.4 m.p.g., and that while consistently driving into the wind.

Those low-ratio rear ends help big engines give gas mileage, but they'll cut it way down when towing. Lugging high-compression engines at a low speed also cuts motor life. Take a lesson from the big semi driver: He maintains good motor r.p.m. by downshifting by r.p.m.s rather than by lug.

There are a lot of cars with automatics pulling travel trailers, and the drivers are enjoying life and not having much trouble, either. I'm just an ex-semi driver who likes his stick shift.

MARTIN HUIKKO, Litchfield, Minn.

More on Patching Tubeless Tires

I'VE been repairing tires for some years now and have a couple of comments on

"The Truth About Patching Tubeless Tires" [May]. To begin with, you picture the buffing of the inside of the tire to remove the special sealer so a patch will stick to it. On older tubeless tires, this will let air percolate out. This slow leak—the headache of servicemen—can be cured by putting a tube into the tire. The idea that a tube is put in to hide poor workmanship is just bunk.

Most garages around here have air-operated tire changers and use them on all tires, tube or tubeless. I've never heard of air pockets between tube and tire casing causing blowouts. We have a system that defeats this. First the tube is inflated fully and let down again. It is then fitted into the tubeless tire while the tire is laid horizontally on the tire changer. The tire is inflated a second time before the tire's top bead is fitted underneath the rim. Inflated, it pushes out the tire walls farther than they'd be in normal use. Then we feel with the hand to insure there are no creases, and deflate the tube. The top bead is now fitted normally, the tube inflated, and the tire put on the car. We've never had a complaint about this method of fitting.

JOHN MUIR, Dartmouth, Nova Scotia.

Test Meter Not Infallible

THE article about test meters [May] was interesting. But anyone using a meter should be warned of the danger involved. Sticking the leads into an outlet can be fatal to the uncautious. Even



when an appliance is unplugged, touching the wrong leads of a power capacitor without first shorting it can result in a rough shock.

Also, a meter cannot indicate every-

CONTINUED



FROZEN IN THE SAME OLD JOB?

It happens to so many men . . .

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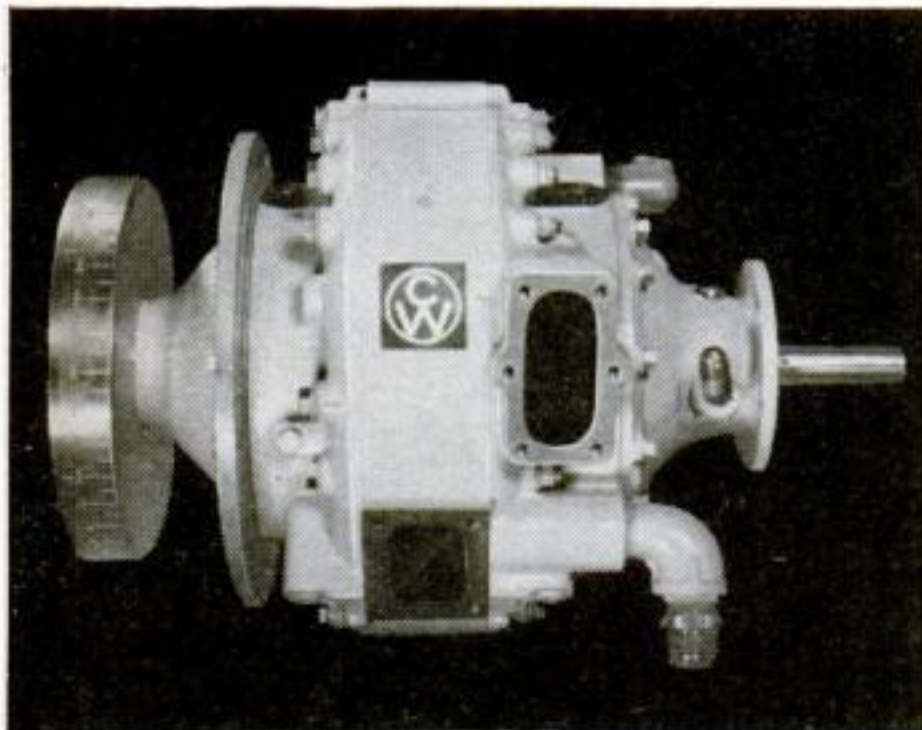
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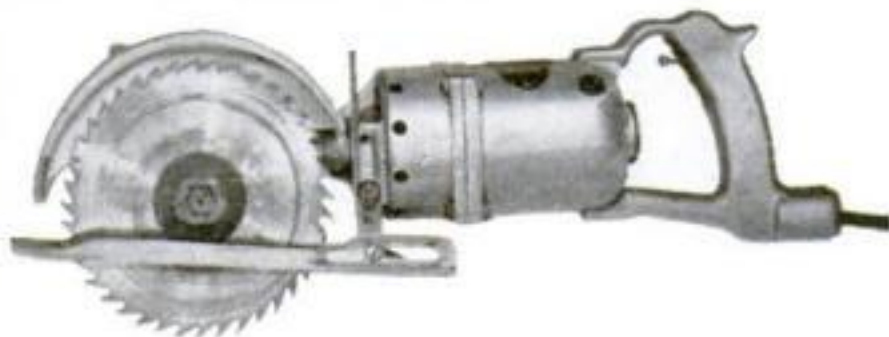
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thing that is wrong; and if it isn't used properly, an incorrect indication is likely. A fairly good knowledge of the circuit is a must for proper testing.

BERNARD KAMOROFF, Baltimore.

Birth of a Saw

SOME time back in a piece on "cut-off" saws, you mentioned that "about 35 years ago the Skil people made tool history by introducing the portable circular saw." I thought you might like to see the saw that started it all.



In New Orleans in the early Twenties, a man named John W. Sullivan met an inventor—Edmund Michel—who had an idea for a portable electric saw with a circular blade. The prototype saw had one big flaw: It ran in reverse. But Sullivan was enthusiastic, the saw was perfected, and the two men started in business in Chicago.

Six production models were made at \$1,000 apiece and Michel set out to demonstrate the tool at Atlantic City's then-new Million Dollar Pier. The Pier's developer stopped at the booth, watched the saw work, and asked the price. Pulling a price out of the air, Michel asked \$160. The Pier developer became his first customer and the first owner of a Skilsaw.

CHRIS HERBST
Skil Corporation, NYC.

It Was a Straight Flush

YOUR short cut, "Easy Way to Flush Your Car's Cooling System" [May, p. 125], is just that. You should have stayed with it, instead of going on to call the procedure "reverse flushing." Reverse flushing is forcing the water back up through the radiator cores.

Since the days of the Model T, I've been reverse-flushing my car, and with not half the trouble you go through. I disconnect the heater hose and clamp it closed. I clamp a four-foot tub-filler hose on the heater nipple below the thermostat and connect the small hose to a garden hose. When the motor is cold, the ther-

CONTINUED

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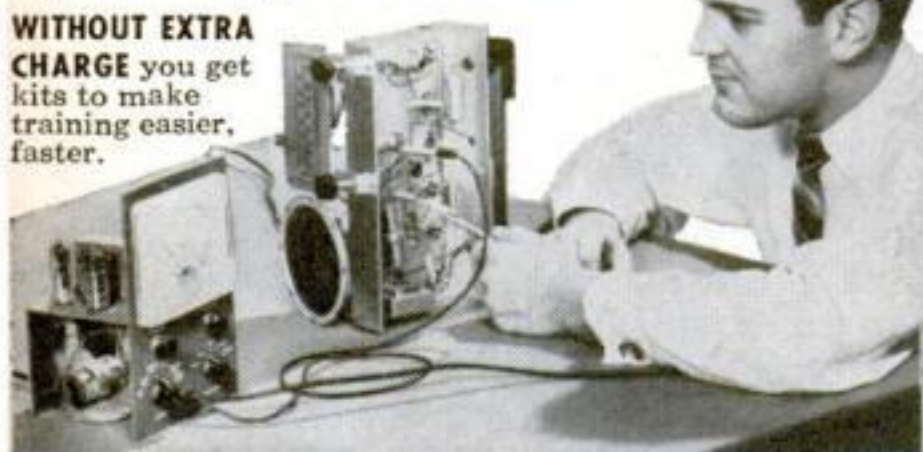
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mostat is closed, so by forcing the water in this way, it can go only one way—in reverse through the block and the radiator.

A. J. MILDICE, Binghamton, N.Y.

Du Pont engineers recommend the short-cut method as a good way to flush the engine and radiator with a minimum of trouble. We'll have to reverse ourselves, though, on what kind of a flush it is. Mr. Mildice is correct.

To Keep the Gardener Going

WHEN your lawn mower or garden tractor is apart, the piston is out, and the rings won't start, try using an automobile hose clamp. It's an old dodge, but it sure works if you're stuck for a small piston-ring clamp.

JOE LUZZADER, Mecklenburg, N.Y.

. . . I FOLLOWED one of your short cuts and mounted two 12" lengths of 1/2" pipe on a house wall to hold my garden hose. But I don't use the hanger as shown in your drawing. Garden hose (and cable, heavy wire, or rope) should always be hung in a figure 8 so it won't kink. It can



be draped that way over the two pipes mounted as you show them, or the pipes can be placed one above the other if space is tight.

J. H. SQUIRES, Newark, N.J.

Back on the Range

ABOUT the discussion of range of the Army's grenade launcher ["PS Readers Talk Back," Apr.], Mr. Pershing should know that an angle of elevation of 45 degrees gives maximum range only in empty space where there's no air drag.

The flight of the projectile is made in dense air which shortens the maximum range. The effect of this is that the maximum is obtained at only 25-30 degrees elevation.

An interesting point: The .30-caliber rifle bullet, Ball M2, a flat-tailed bullet,

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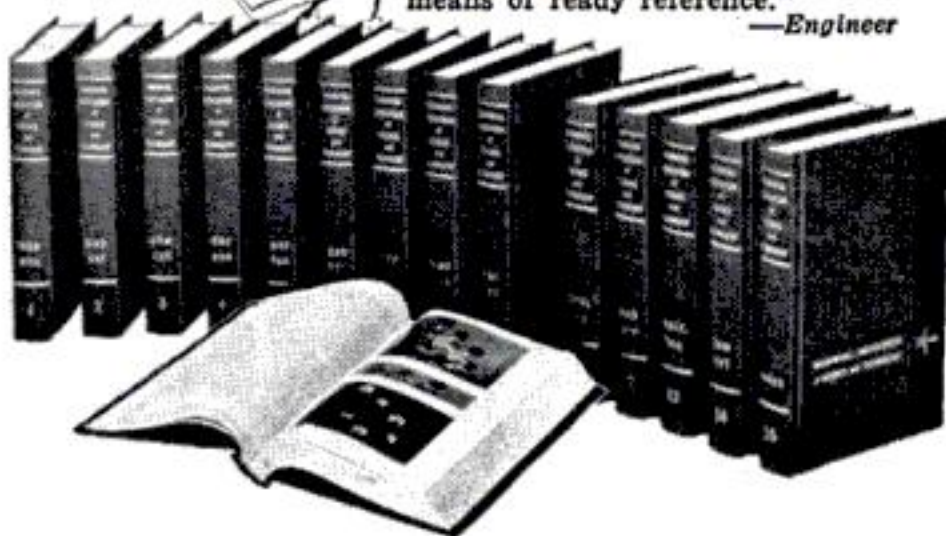


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B. J. HAMMOND, Vista, Calif.

Request to Letter-Writers

NEARLY 4,000 readers have written to me since the articles on my Wonderlux wood finish appeared in POPULAR SCIENCE. Because of health, I have retired from my lifetime's work and turned my woodfinishing shop over to my son, who has worked with me for years.

I am always glad to receive letters



from PS readers; but, please, those expecting a reply should be sure to enclose a stamped, self-addressed envelope.

R. C. STANLEY, Canton, N. C.

The Fascinating Monitor

YOUR pictorial essay on the Monitor ["History's Strangest Warship," Mar.] included many interesting details that I've never seen published before. You showed just enough of Ericsson's engine, however, to arouse my curiosity. I wonder if you have any more details on how the odd linkage was connected to the crank, and how the valve motion was handled and controlled?

J. D. RATT, Valley Stream, N.Y.

Ericsson ordered that all his drawings be destroyed on his death, so details of his engine are hard to find. PS' cutaway was created from extensive research.

The engine, in Ericsson's own words, "is of somewhat peculiar construction; (it) consists of only one steam cylinder with pistons at opposite ends, a steam-tight partition . . . at the middle. The propeller shaft has only one crank and one crankpin, the difficulty of 'passing the centers' being overcome by placing the connecting rods, actuated by the steam pistons, at right angles . . ."

We did not feel confident enough of

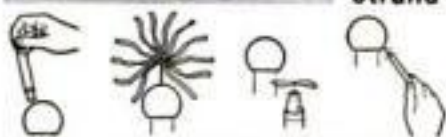
[Continued on page 35]



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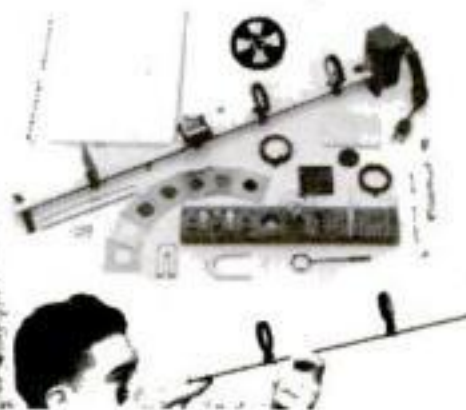
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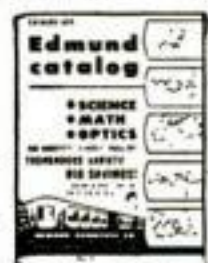
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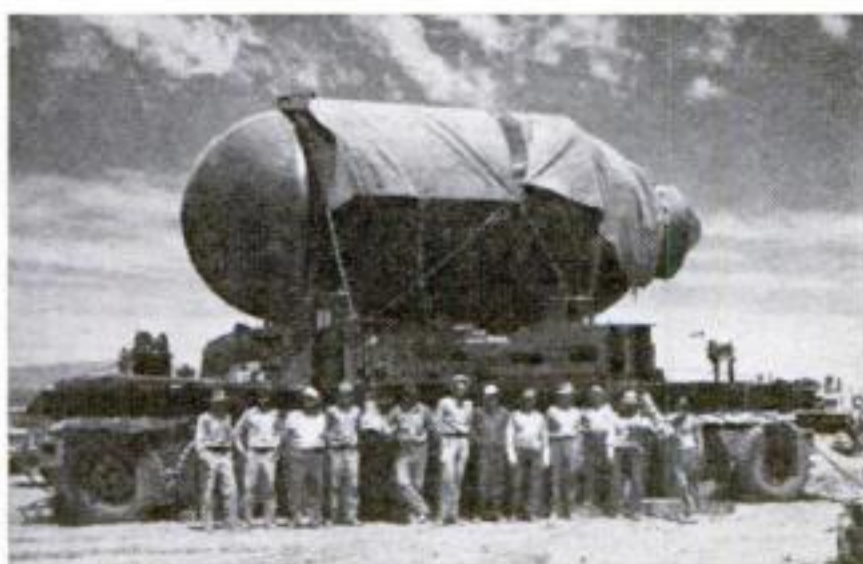
By Martin Mann

The month in science

Jumbo, the atomic white elephant. If the Chamber of Commerce of Socorro, N.M. (pop. 5,271), gets its way, the tourist park near the junction of U.S. 85 and 60 will have an imposing monument, a rarity among memorials because it commemorates a mistake. And the U.S. Government will finally be rid of Jumbo, 214 tons of mistake.

Jumbo is a steel tank, one of the heftiest ever built. It looks like the vacuum insert for a Thermos bottle—only it is 25 feet long, 12 feet in diameter, and has walls 15 inches thick. Its story is a sadly funny tale, one of the oddest of the many odd footnotes to the early history of the atomic age.

In 1944 the scientists at the secret laboratory in Los Alamos were



In 1945, Jumbo rode regally on its own trailer.

designing the first atom bomb, code-named Fat Man. They were pessimistic. They thought they might eventually make The Gadget work, but they didn't think there was much chance it would work on the first try. The worst part was that they couldn't afford to lose Fat Man's priceless plutonium; if the plutonium failed to react, it would be scattered all over the New Mexico desert by the force of the TNT detonator (several thousand

pounds). No one doubted that the TNT would go. So they decided to set off Fat Man inside a bottle. Jumbo was to be the bottle. It wasn't meant to contain an atomic blast—if Fat Man went, Jumbo would go too, and no tears shed. But Jumbo was strong enough to contain the TNT blast alone. If Fat Man's plutonium failed to react, it could be scraped off the inside of the tank and used for another try.

Jumbo arrived at The Site two months before the mushroom cloud that was to alter the course of history. It rode majestically on a special trailer—eight rows of eight wheels each, all independently sprung—pulled by four tractors. But by then the scientists didn't want it. They were fairly confident that Fat Man would work.

Jumbo was left hanging empty from its steel scaffold 800 yards from Ground Zero. The world's first atomic blast crumpled the scaffold but didn't hurt Jumbo. It proved its strength again when a bungled attempt to destroy it with eight 500-pound demo bombs did nothing but blow the ends off. So Jumbo was rolled into a trench. In 1951 it was dug up only to be abandoned once again—it had been suggested for use in an experiment but proved unsuitable. For nine years Jumbo lay unwanted in the desert. Then last summer the Socorro businessmen asked for it—and nobody could find it. Finally Jumbo was uncovered just outside the

CONTINUED

The month in science continued

fence that encircles Ground Zero. Now it is Socorro's problem.

Is the U.S. patent system doomed? "I don't mind telling you flatly, unless a solution to the search problem is found soon our patent examination system is in danger." The speaker is the new boss of the patent office, David L. Ladd. Commissioner Ladd is the very model of the current administration's executives: young (35), husky, good-looking, smart, fast-talking, and informal (shirt sleeves, feet on the desk).

In an exclusive interview with *Popular Science*, he outlined his plans. He is seeking ideas to ease the lot of the independent inventor (such as a preliminary application form, to be filed as soon as an idea is conceived, that would automatically prove who was first and eliminate protracted, expensive "interference" proceedings). But, he says, "The search problem comes first."

That problem is easy to state, very tough to solve. A U.S. patent can be granted only for a genuinely new invention. To make sure it is new, examiners must literally search through the earlier patents. This has always been difficult. Now, with 3,000,000 patents in the files and 1,000 new ones being added every week, it is becoming impossible.

The only way out is searching by machine. The machine doesn't exist yet, although Government and industry have been pushing hard, because a couple of crucial items need to be invented. One necessity is a good reading device—to convert the 3,000,000 existing patents into punch cards or magnetic tape that the searching machine can search through. Another necessity is some basic discoveries about language—how is the machine to tell if "bridge" means highway bridge, spectacle bridge, or a card game?

If machine searching is not perfected, Commissioner Ladd foresees fundamental—and undesirable—changes in the patent system. The French patent office doesn't try to search, he points out—there you have to fight out conflicts in the courts (a special disadvantage to independent inventors, who are usually broke). The English search, but disregard all patents more than 50 years old. Comments Ladd, "I'd hate to have a blanket rule cutting off all patents at the end of 50 years. Some of those German chemical patents from the late Eighteen Hundreds are just now coming into commercial use. It would be unfair to let late-comers re-patent those old ideas."

More than the patent system is involved. The whole world needs the searching machine. Libraries are running out of space. And they are already so big that you can't find anything in them—it's easier to rediscover needed information than to look it up. Patent searching is the most complicated kind of information retrieval, however. Ladd says, "If we can solve the problem for patents, we solve it for everything."

Synthetic Metrecal for spacemen. National Institutes of Health scientists have concocted Diet 116, a nutritious goop so concentrated that a drawerful would keep an astronaut well fed for a month. It looks like weak tea and is as thick as milk, but can be manufactured from coal, air, and water (unlike the commercial diet-in-a-can stuff, which is derived from milk). A small factory could produce enough to feed millions of people.

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PS Puzzlers By Joan Steen


By Joan Steen

Tough nuts for summer cracking . . . Answers on page 181

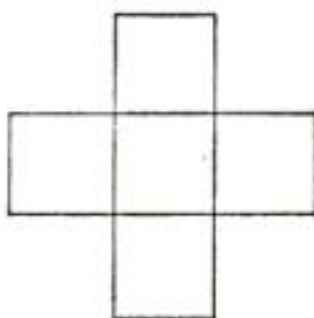


Crosses and Double-Crosses

GET out pencil, paper, scissors, pliers: I have proclaimed August Do-It-Yourself Puzzle Month. We will begin with H. E. Dudeney's summary of Greek Cross Puzzles. A Greek cross is made of five identical squares (right).



Problem 1: Cut the cross into five pieces which can be put together to form a square.



Problem 2: Improve on that: Cut the cross into four pieces all the same size and shape and form a square. (There's only one way to do it.)

Problem 3: Try again with four cuts, this time using only two snips of the scissors. (The pieces won't be symmetrical.) Hint: You might begin by seeing what the length of the side of the square must be if its area is the same as the cross.



NOW help Koko, the native chief, with his transport problem: How can he get three choice coconuts, weighing two pounds each, across a footbridge with a capacity of 250 pounds if he himself tips the scales at 248 pounds? He can't leave any behind because the monkeys will eat them.

HAVE you ever tried to crack a code? This little division problem is as good a start as any. Like an expert decoder, you must bring to bear on the problem whatever facts you know about the language (in this case the number system) plus some trial and error. It's a challenging exercise.

WHAT? another cross? A reader asks that you try drawing an X on a piece of paper without lifting your pencil or recrossing a line.

Which in turn reminds me of a more strenuous version: Can you tie a knot in a piece of string without letting go of either of the ends? (Try that at a party.)

[illegible]

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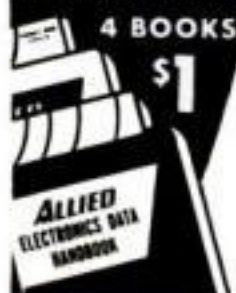
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PS Puzzlers

continued

THIS fellow needs your help: He's going on vacation and he wants to take his hunting rifle with him on the train. The conductor says, "No, sir, not on this coach!" The baggage-car attendant says, "Sorry—we're under strict orders not to accept anything over a yard long in any dimension. Your gun measures 1.7 yards."

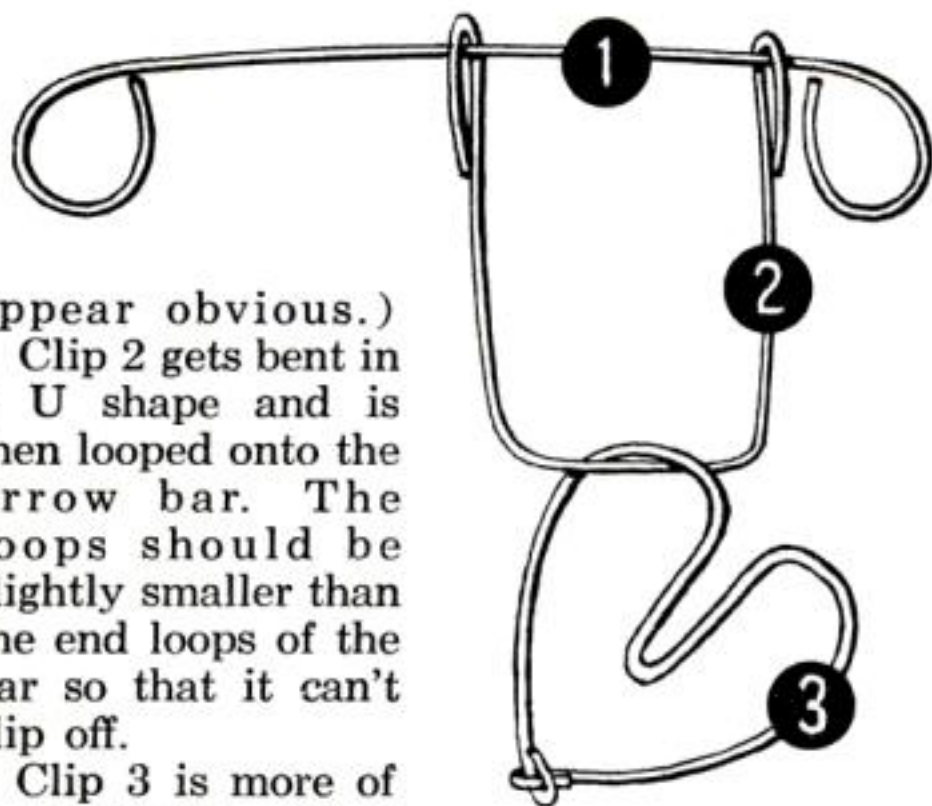
Got any ideas how he can do it? Of course, ground rules prohibit any disassembling of the gun.



Puzzle of the month

I WARNED you this was Do-It-Yourself Month. You have to construct August's P-O-T-M as well as solve it. (Blame Jack Gampinsky of Brooklyn, N. Y., for this.) You need three paper clips, a pair of pliers, and a steady hand. After that you need patience.

Clip 1 is straightened out and closed by loops at each end. (More artful souls should attempt an arrow head at one end for reasons that will



appear obvious.)

Clip 2 gets bent in a U shape and is then looped onto the arrow bar. The loops should be slightly smaller than the end loops of the bar so that it can't slip off.

Clip 3 is more of a challenge. It's a heart that is to hang from the bar in between the loops of the swing—imprisoned there. I caution you to follow as accurately as you can the shape outlined here, and to be sure to slip it around the bar before you close off the ends. For clarity we've shown the heart looped around the bottom of the U shape. It slips around easily.

Now that you've joined these three pieces inextricably and eternally, can you remove the heart from the end of the arrow bar without forcing any parts? (Answer next month.)

Answer to last month's P-O-T-M. Three Dutchmen and their wives went hog-shopping. Each bought as many hogs as the price he paid per hog. Claas bought 11 more than Geertring, and Hendrik 23 more than Catrun. Cornelius and Anna are the other two. Husbands spent \$63 more than wives. Match the couples.

Clearly this is a problem involving squares of whole numbers (no half-hogs allowed!). And clearly Hendrik is not married to Geertring nor Claas to Catrun (11 and 23 would have to divide evenly into 63 in that case). But you can write an equation for each married couple of the form $a^2 - 63 = b^2$. For if a is the price Hendrik paid per hog, we know he bought exactly a hogs and his total outlay was $\$a^2$. Similarly, if his wife paid $\$b$ per hog she spent a total of $\$b^2$. Now the simplest approach is to run through a table of squares and mark off pairs of numbers whose squares differ by 63. (You have an upper limit in this at 32—after that, consecutive squares differ by amounts larger than 63.) But right off the bat you find a qualifying pair: 1 and 8 ($64 - 1 = 63$). Furthermore, add 11 to 1 (using another clue) and you get 12, which is half of another qualifying pair: 12 and 9 ($144 - 81 = 63$). Now will the 9 work out with the third clue? Hendrik bought 23 more hogs than Catrun. $23 + 9 = 32$ which does qualify: $32^2 - 63 = 31^2$. Furthermore, no other pairs of numbers satisfy all conditions. So Claas is married to Catrun, Cornelius to Geertring, and Hendrik to Anna.

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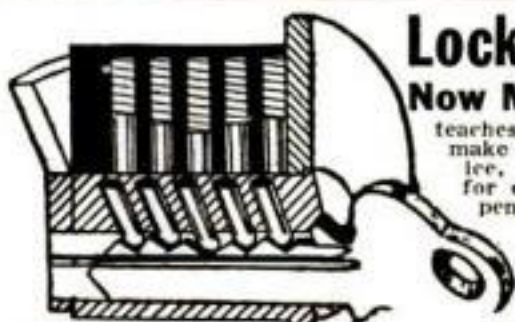
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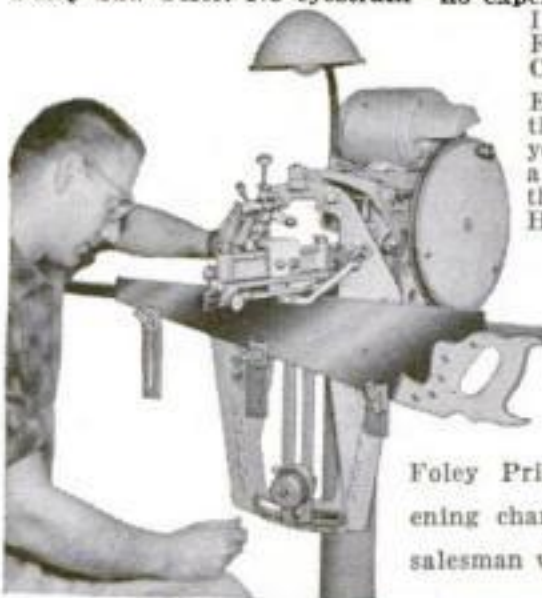


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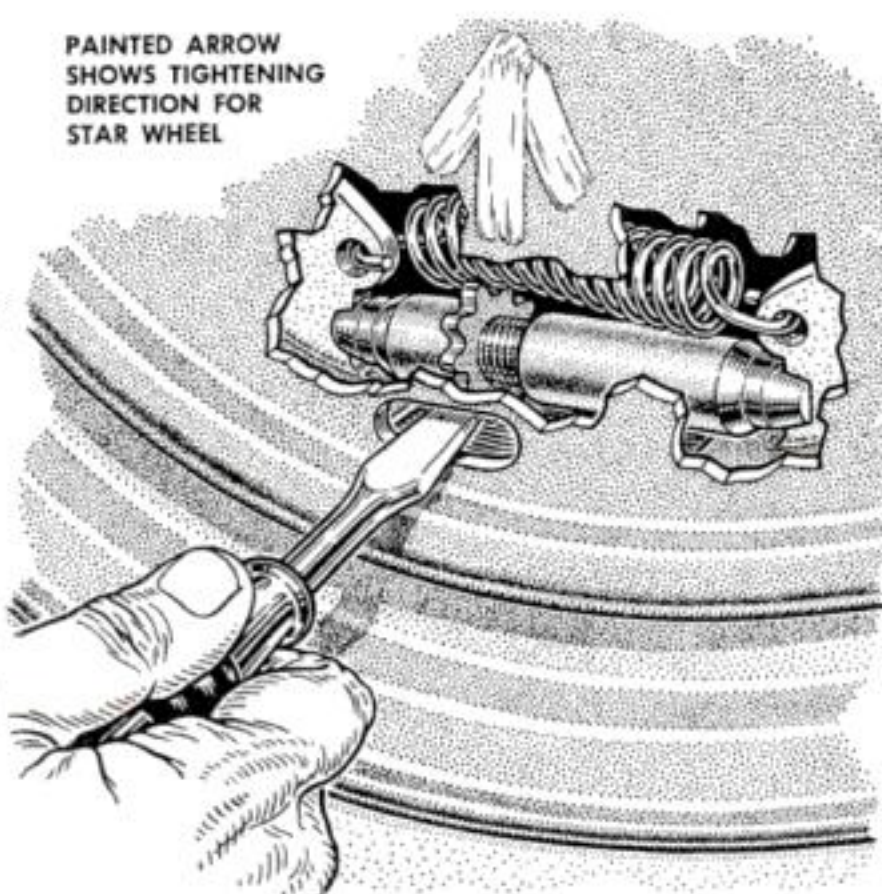


Hints from the Model Garage



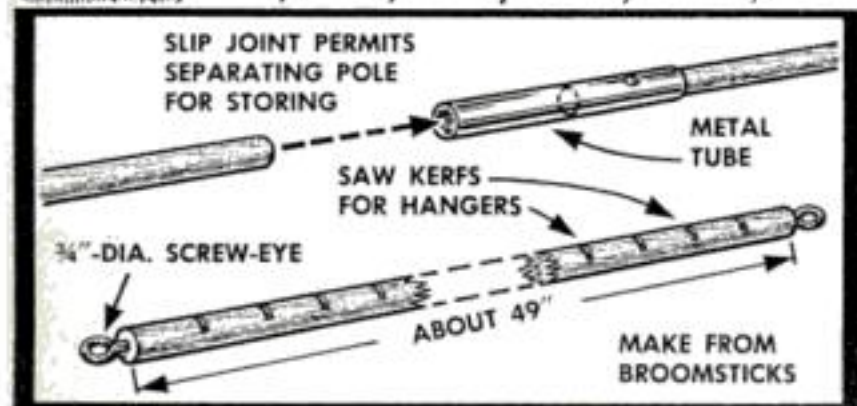
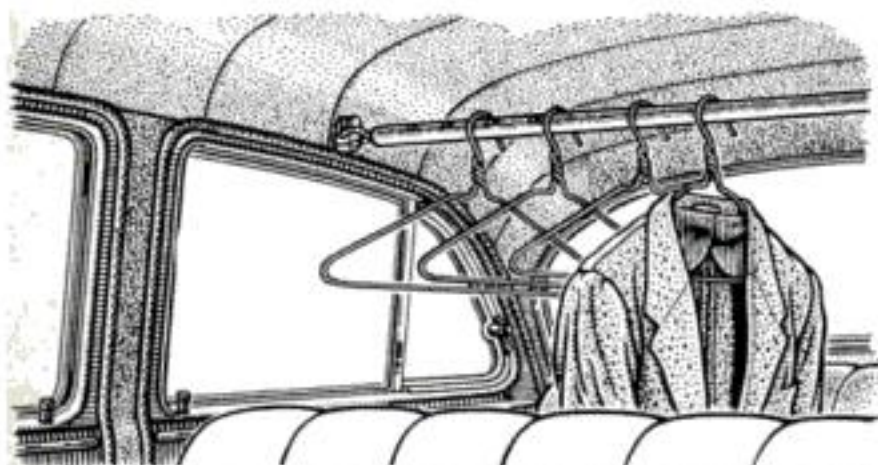
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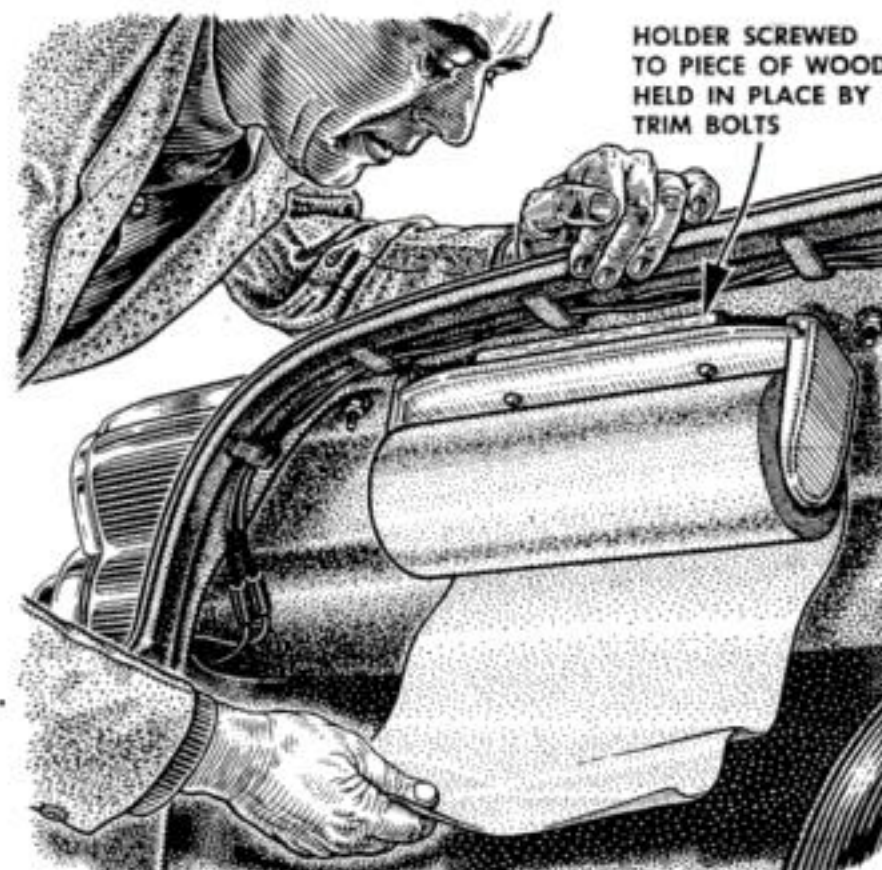


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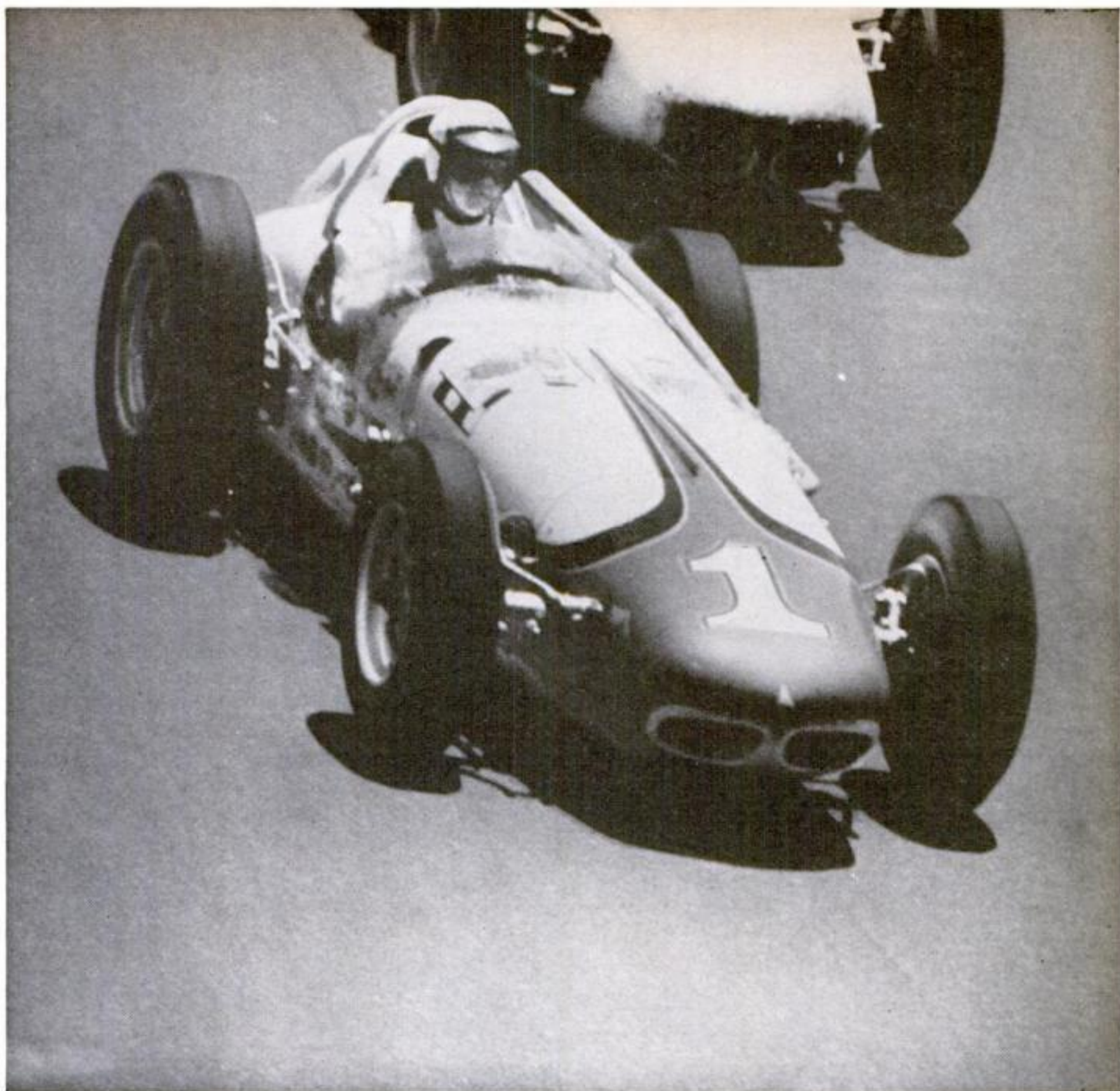


A sturdy clothes pole can be made by driving a screw-eye into each end of a broomstick and suspending it from the clothes hooks usually found in a sedan. Lacking hooks, remove two trim screws and insert screw hooks in their holes.



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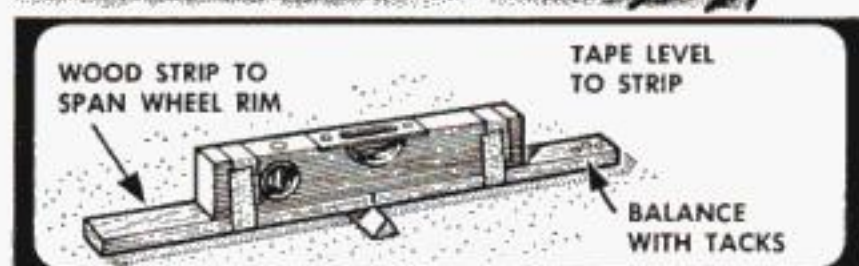
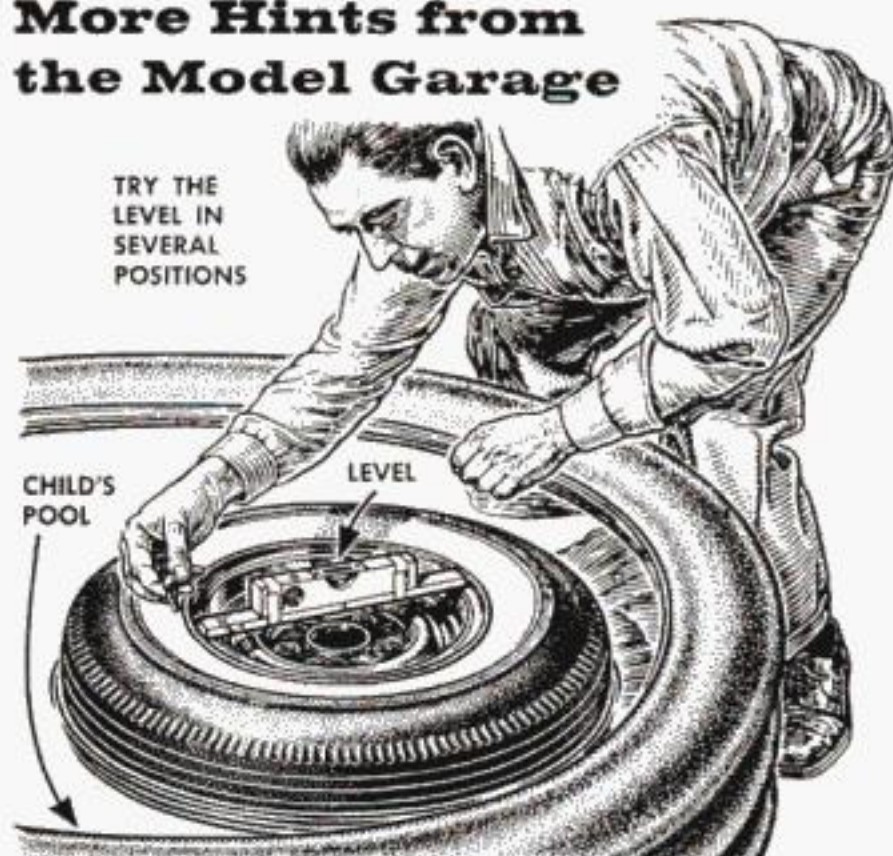
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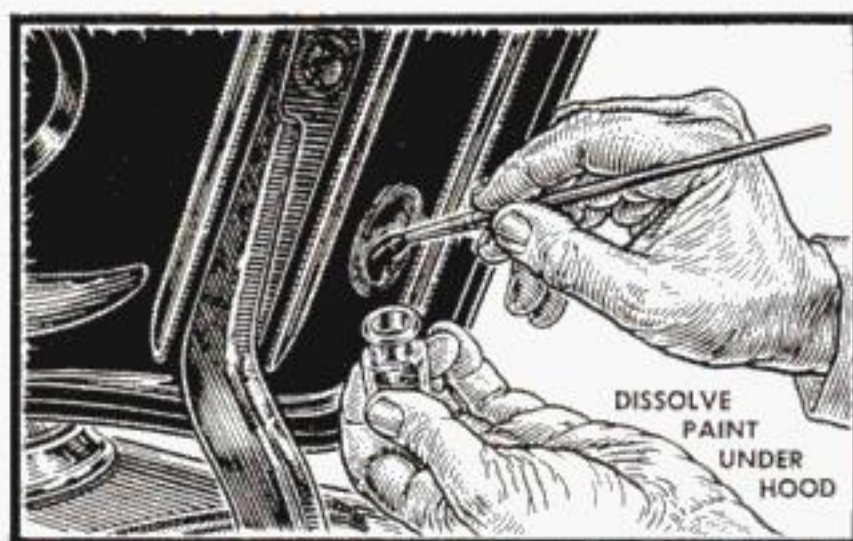


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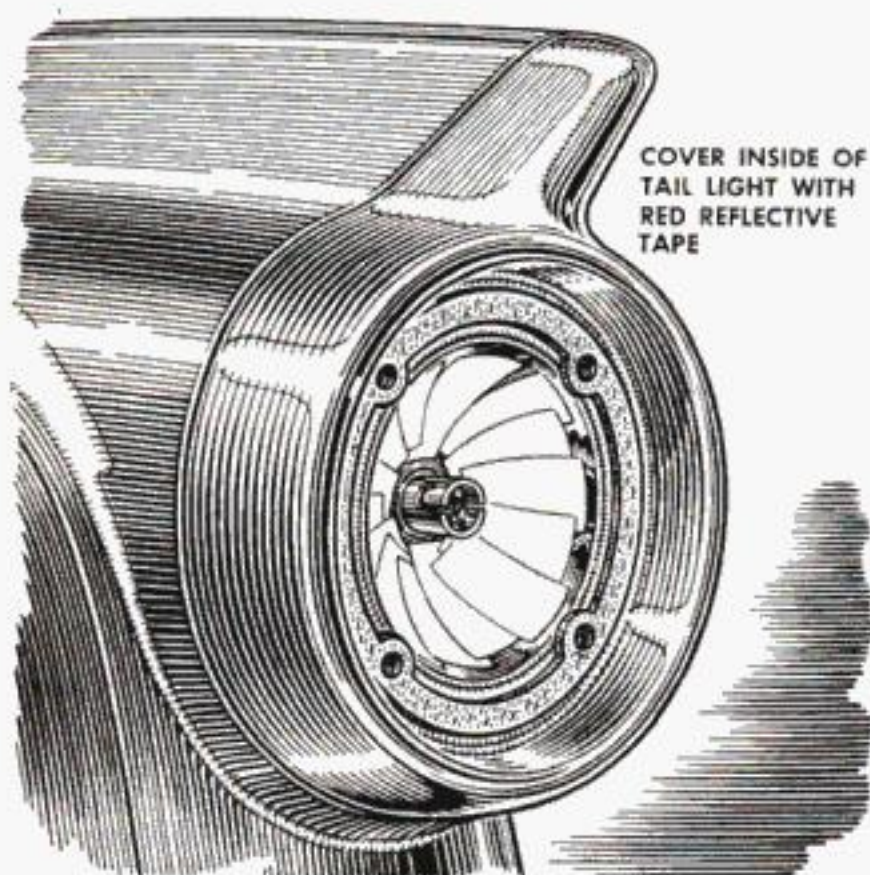
More Hints from the Model Garage



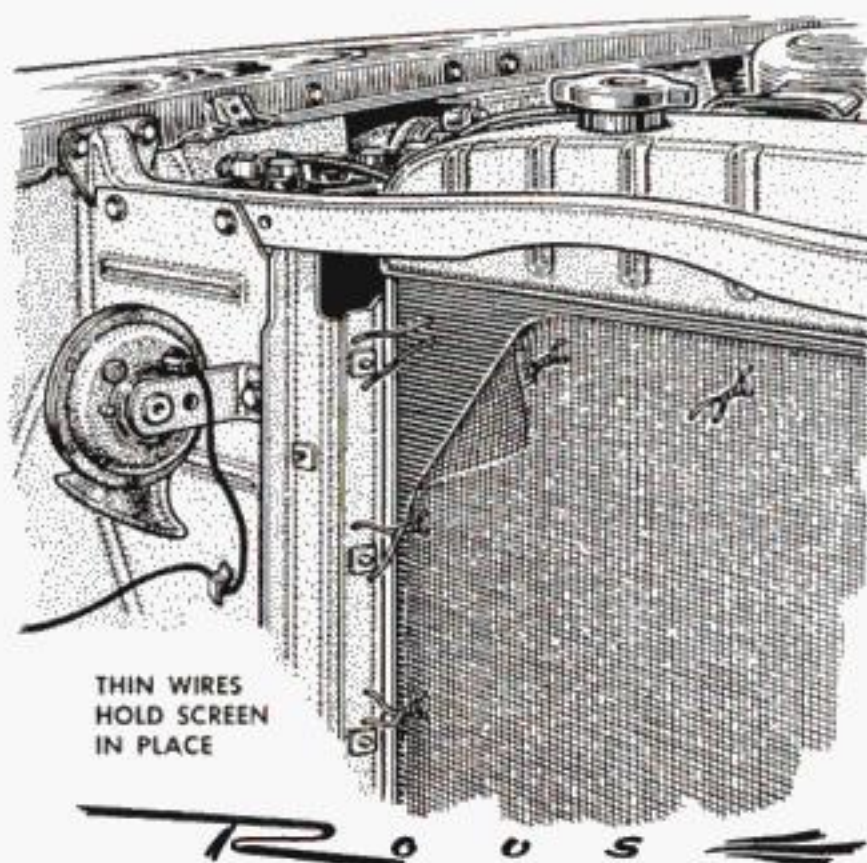
Balancing wheels precisely is easy if you float them in water. Center a level on a stick long enough to span the rim, and try the level in several positions. Add weights to the high side until the wheel floats perfectly level.



A touch-up will match perfectly if you dip a small brush in a thimbleful of lacquer thinner and rub it repeatedly over some unseen area of the finish. When the paint dissolves on the brush, apply it immediately to the scratch.



Tail lights will reflect more light from oncoming cars when off, and glow brighter when lit, if you cover the inside with red reflective tape. When you put back the lens, the tape is hidden, but its reflective quality is not impaired.



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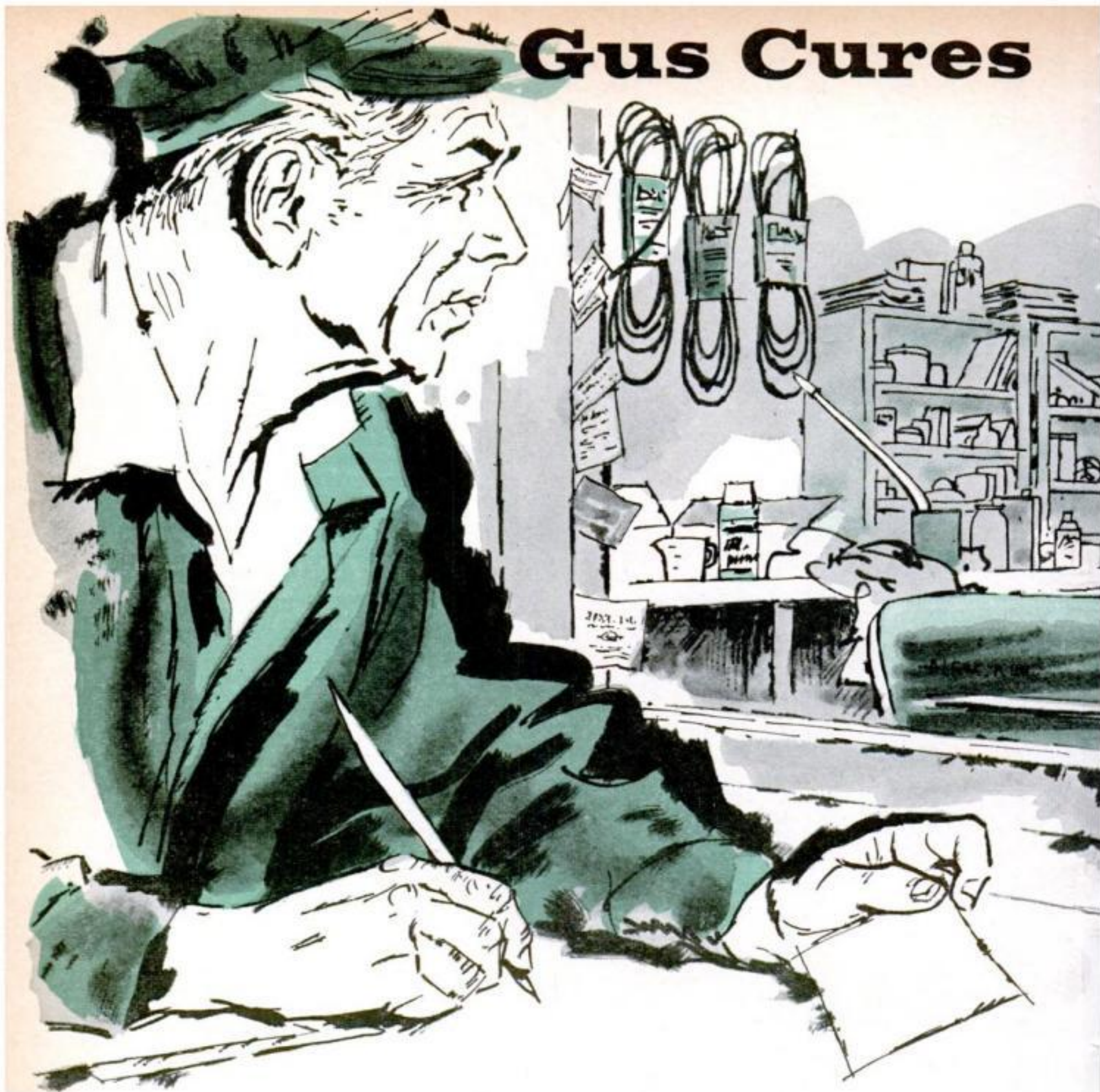


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Gus Cures



By Martin Bunn

"STAN!" called Gus Wilson from the office door. "While you're . . . Stan?"

There was an empty silence in the Model Garage as Gus looked for his missing assistant. He crossed to the open shop door and looked out.

Alongside the air-gauge stanchion stood a big, four-or-five-year-old hardtop, its hood up. Two slim figures were bent over the engine—Stan, in coveralls, and a young man in slacks and sports shirt.

Both straightened simultaneously as Gus called again.

"If it's about Mr. Gilpert's car," Stan said, "the lube job's done."

"Fine. He phoned to change the oil while you have it on the lift."

"Will do," Stan said, starting off toward the shop.

"Hold it, Stan," said Gus. "The oil change can wait if you have a customer."

"Uh—not exactly, Boss. That is, he's a friend of mine."

The young man turned as if on cue, to show a sandy-haired, cherubic face in a fringe of fuzzy beard.

"Hello," Gus said. "It's Kendrick Holcomb, isn't it? How's college?"

"Okay, Mr. Wilson," returned the

the Big-Car Blues



Twice Holcomb jumped into the big car and drove out. Each time he returned, the beard-fuzzed chin seemed to sag lower.

youngster. "I didn't think you'd remember me."

"The face is familiar," replied Gus. "But the car sure has changed."

"Just got it," said Holcomb with a proud glance at the road locomotive.

"See you again," said Gus, and headed back to the shop. Before he entered, he caught the first words of renewed discussion.

"Those cats sure won't go for a laggin' wagon. It's gotta have some oomph . . ."

ENGROSSED in adjusting a troublesome clutch, Gus heard the lift sigh its way down and the Gilpert car drive off it.

Shortly afterward, Stan sauntered over and stood beside him.

"Something on your mind, Stan?"

"Need some advice—Ken and me, I mean."

"I'm almost through with this job," said Gus. "Why don't you drive your pal's car in?"

Stan bestowed on him the sort of look reserved for mind readers. When Gus walked over, the big car was gleaming under the shop lights.

"Let me explain," began the lightly bearded youth. "It's . . ."

Stan waved an urgent appeal for silence. "Boss, the college types where

Ken's studying have taken up these big luxury cars as a fad. He found this one on a trip upstate, tagged so low he can sell it at a good markup."

"That's if it runs good," broke in the bearded youth. "But it's gotta have sass . . ."

Stan flagged him down again. "It lost its pep, Gus, when Ken drove it here. I'd like to check it out. He's short of money, so I'm in with him."

Gus nodded gravely. "Makes it sort of in the family. Go ahead. First I'd check the usual tune-up spots."

TWICE while Gus was writing checks for jobbers' bills, Holcomb jumped into the big car and drove it out. Each time he returned, the beard-fuzzed chin seemed to sag lower than before.

"How's it going?" asked Gus.

Stan shook his head. "Plugs are new. Timing's right on the nose. The air filter is clean and carburetor settings seem okay. Points were kind of dirty, but I cleaned and set them. They're not pitted enough to be the trouble."

"Those new plugs may not be gapped right," said Gus. "While you have them out, you might check compression."

A customer back for his car kept Gus busy briefly, but he returned to the big sedan in time to see Stan check the last two cylinders.

"Close to 125 pounds all around, Gus. Nothing wrong there."

Gus nodded. The plugs, carefully re-gapped, were reinstalled. Stan started the engine. It ticked over like an expensive watch. But as soon as the throttle

was opened its even beat faltered and turned rough.

"Could be that those points are dirtier than they look, or pitted enough to take the fine edge off the setting at high speeds," Gus said. "I'd try new ones. Or it could be sticking valves; a can of top lube might be all you need."

"Money!" croaked Holcomb.

"Ken's sort of broke," Stan explained, "after having to buy new plugs on account of an oil change."

"His credit's good for a set of points," said Gus. "Top lube's cheap."

"We'll try the points, thanks. No car ever needed top lube less."

PONDERING this cryptic remark, Gus went back to addressing his envelopes. Through the office window he saw Stan remove the distributor to install the new points.

Soon the big car rolled out again. But even as Holcomb fed it gas to climb the door apron, its faltering note told Gus the trouble was still undiscovered. Sorry he'd suggested new points, he sealed the last envelope and sauntered over to

where Stan stood in the open doorway.

Gus hardly had his pipe alight when the sound of a big engine swelled over the street noises. A moment later the sedan rolled in again.

"No?" asked Stan.

Dolefully the bearded youth shook his head. "Man, this one's really dead."

Gus asked, "Why did an oil change make you buy new plugs?"

"Real square," said Holcomb. "I mean this character at the service station. I tell him to change the oil, while I eat. So

Where'd it come from?



The unknown "x"

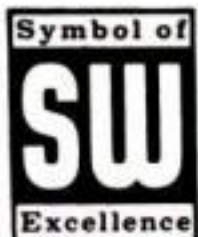
The Greeks were such concrete thinkers that they didn't bother to develop an algebra with abstract "unknowns." The closest they got was Diophantus's, which some think may be a version of the word *arithmos*—number. The Egyptians hold the earliest claim to equation writing: A manuscript of 1800 B.C. speaks of the unknown as "hau"—heap. The Hindus did better. They used abbreviated syllables or initials of objects, but they also had plus, minus, and equal signs.

The 16th century Frenchman, Vieta, is credited with first using capital letters for unknowns. Fifty years after his death Descartes' *Geometrie* appeared which specified that the beginning letters of the alphabet be used for given quantities, the end letters for unknowns—and so it is still done today.



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I come out, pay him, and drive off. In about five miles, the engine begins to make like a bucket of bolts. Of course I go back, but fast."

"What he'd done, Gus," put in Stan, "was forget to drain the old oil. He poured five extra quarts on top of it."

"Crazy, hey?" asked Holcomb. "So he apologized, drained it, and put in five fresh quarts. Man swore no harm was done—that the racket was because foaming oil made bubbles in the hydraulic valve lifters."

"It ran okay then?" asked Gus.

"Ran quiet. Guess I was a hundred miles away before it flashed on me that the old pep was gone. Stopped again and

shaft pulley as Holcomb started the engine. The red flash showed the timing mark rock-steady in line with the pointer.

"See? On the nose," said Stan.

"Right," said Gus. "Now reconnect the vacuum-advance line, but leave the light."

Puzzled, Stan complied. Gus speeded up the engine. The timing mark didn't budge.

"Spark advance isn't working," said Gus. "That's why the car has no pep."

"Money?" squeaked Holcomb in alarm.

"Maybe not. Stan, remove the vacuum advance."

Taking the double-chambered unit from Stan, Gus tilted one of its two vacuum-line couplings downward. Oil trickled out onto his palm.

"Should be nothing but air—or vacuum—in there," he said. "This oil blocked the diaphragm. Vacuum couldn't advance the breaker plate. There's no centrifugal advance on this model, so your spark stayed fully retarded."

"How'd oil get in?" asked Stan.

"With a 10-quart level, it traveled up the distributor shaft. Normal wear left enough clearance around it, and the helical gears could act like a pump. Oil probably filled the distributor case to just under the points, then flowed along

the arm that links this diaphragm to the breaker plate.

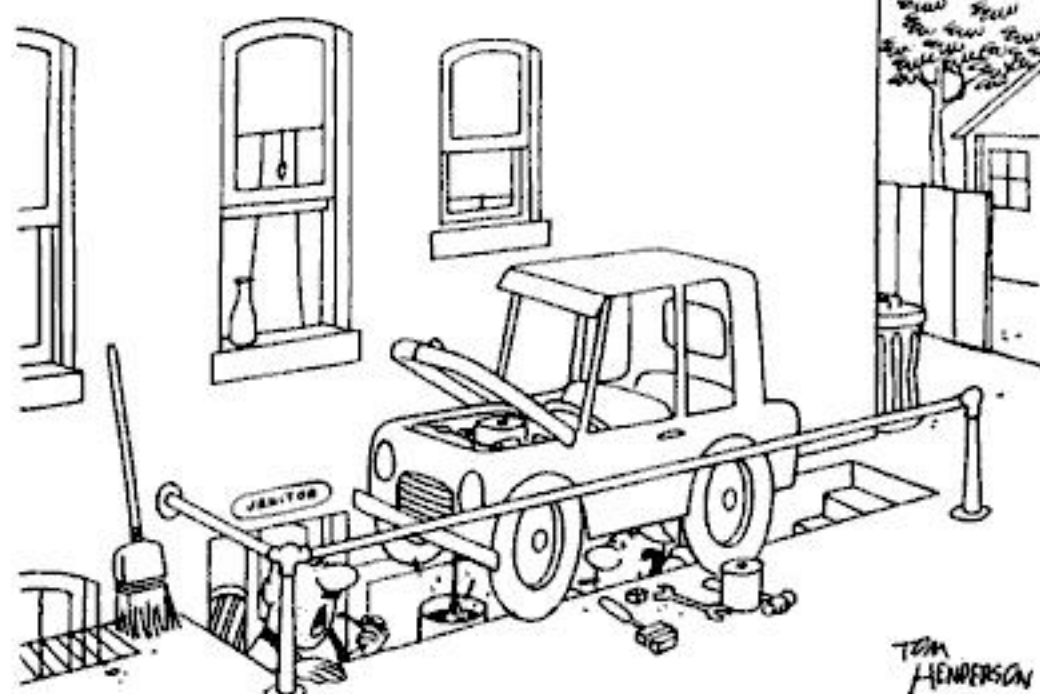
"The diaphragm must have had a pinhole leak before—manifold vacuum would advance the spark despite a small one. Then the vacuum pulled oil through the pinhole. Once enough oil got to the other side, the vacuum couldn't pull the weakened diaphragm against it."

"Cool thinking!" breathed Holcomb.

"Better junk this unit," advised Gus. "We replaced a worn distributor on a car like this not long ago. It's still here. You can take the vacuum advance off it."

"Knowing about that oil change, I should have figured this one," said Stan.

"It wouldn't have made any difference at all," said Gus. "What turns out to be at the bottom of any grief is always the last thing we check." ■ ■



"I'll thank you to work on your car someplace else!"

a service man showed me the old plugs were oil-fouled. Sold me a new set."

"That's why I can't see using top lube," put in Stan. "It had a big oil bath. But the valves quieted, so I figure the oil didn't do any more harm than foul up 12 bucks worth of spark plugs."

"Money!" winced Holcomb.

"No other place all that oil, way above normal level, could go to make trouble," said Gus.

"Maybe that's what fouled the points," said Stan, "but we've got new ones in now."

Gus knocked out his pipe. "Let's see. Hook up the timing light again."

STAN hooked the light to the No. 1 plug, disconnected the vacuum advance, and held the light near the crank-

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PS Readers Talk Back

[Continued from page 10]

recreating the correct linkage to let the artist show this clearly.

... THERE seems to be disagreement between your article and a book published in 1899, *The Great Wars of the World*, that I have been reading.

You say: "Two 11-inch smoothbore guns in the turret, firing solid 168-pound shot, ripped iron freely off the Virginia." Well, ripped off iron freely is not accurate according to my book which indicates that although the Monitor bent a few plates on the Virginia (or Merrimac), it definitely did not knock off or penetrate one plate.

WM. JAKUBOWSKI, Syracuse, N.Y.

In his official report to the Secretary of the Navy, Capt. John L. Worden himself said: "I turned back with renewed confidence and hope and continued the engagement at close quarters, every shot from our guns taking effect upon the huge sides of our adversary, stripping off the iron freely. Once, during the engagement, I ran across and close to her stern, hoping to disable her screw, which I could not have missed by more than two feet."

The battle took place at remarkably close quarters and the Merrimac's armor—railroad iron over a wooden hull—was a makeshift compared to the Monitor's all-iron construction. Had the order permitted Worden to load the guns with a reasonable powder charge, he might well have sunk the other ship, since she was without armor below the water line.

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PHOOEY on those 20-second automatic turn signals on the Simca ["PS Readers Talk Back," May]. On my Simca, the turn signal broke down after a year and I couldn't be happier. Now it's strictly manual, either on or off.

I liked the automatic idea till I made a few left turns with heavy traffic or a red light. By the time it was my turn, the signals had canceled and I was cutting through traffic with no signals. I didn't like the possibilities on immediate turns, either. I'd be signaling for turns I didn't want for a few blocks. Now it's all up to me.

C. J. PRITLOVE, Guelph, Ont.

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DETROIT REPORT

By Devon Francis

What's for 1962?

WE'VE already listed—in June and July—the coming “senior” compacts, Buick's radical V-6, and the revival of wire wheels. Now, with the bulk of the new-model car announcements

scheduled for late next month—two weeks earlier than usual—we've had seismographs recording rumblings of further changes.

Chrysler Corp. will have at least one added line of cars in the 115-inch wheel-base class to compete with Ford's “X” and “Y” cars and Chevrolet's H-35.

Again Chrysler: The corporation will stretch the time between lubrications on all its cars, even as Ford Motor did for 1961. Cadillac, it will be remembered, wholly eliminated the need for periodic lubing on its 1961 cars.

Fuel injection? This is a hush-hush item. A strong report says that one—just one—1962 car will introduce an optional fuel-injection engine. This will make two—Chevy's Corvette sports car,

of course, already offers optional fuel injection.

Three years ago fuel injection flopped badly. It was too costly, demand lagged, and performance was disappointing.

Poor man's power seat. One automobile manufacturer has ordered 10,000 low-priced, manually operated seat adjusters for 1962. This do-it-yourself unit

will permit the driver to tilt the front seat forward or backward hydraulically, by pumping a handle. Naturally, the seat will slide backward and forward, too.

Aluminum bumpers. On a field-test basis, Pontiac will equip 5,000 of its cars with aluminum bumpers for '62. Insiders report that aluminum suppliers have agreed to provide the bumpers cheaply in exchange for the right to advertise

the news that they actually are being used on production cars.

Creditable reports say the bumpers will be used on air-conditioned Pontiacs, where the 25-30-pound weight saving would be most beneficial.

The ever-level car. How many times have you had to cope with headlights that stabbed the sky when you had the back end of the family car loaded down?

Well, the fellows who keep bird-dogging automatic levelizers—regardless of load—

are at it again. Now they are experimenting with torsion bars. A sensing device trips an electric motor that twists the base of the torsion bar according to load, making it stiffer or softer. It's like Packard's rig in the mid-Fifties.

Weight costs gas. An auto-industry study has measured the effect on fuel consumption of the number of passengers in a car. A 2,550-pound Comet got gas mileage of 22.7 miles per gallon with one passenger, 22.2 with two passengers, 21.7 with three passengers, 21.2 with four

passengers, 20.7 with five passengers, and 20.2 with six passengers. This was typical city-suburban usage.

A product planner can increase mileage of a 2,500-pound car in city-suburban driving by a tenth of a mile per gallon for each 25 pounds of weight he removes.

And what's new for 1963? Look for alternators on the 1963 cars of Ford Motor Co. and General Motors. Despite reports that Ford's acquisition of the two

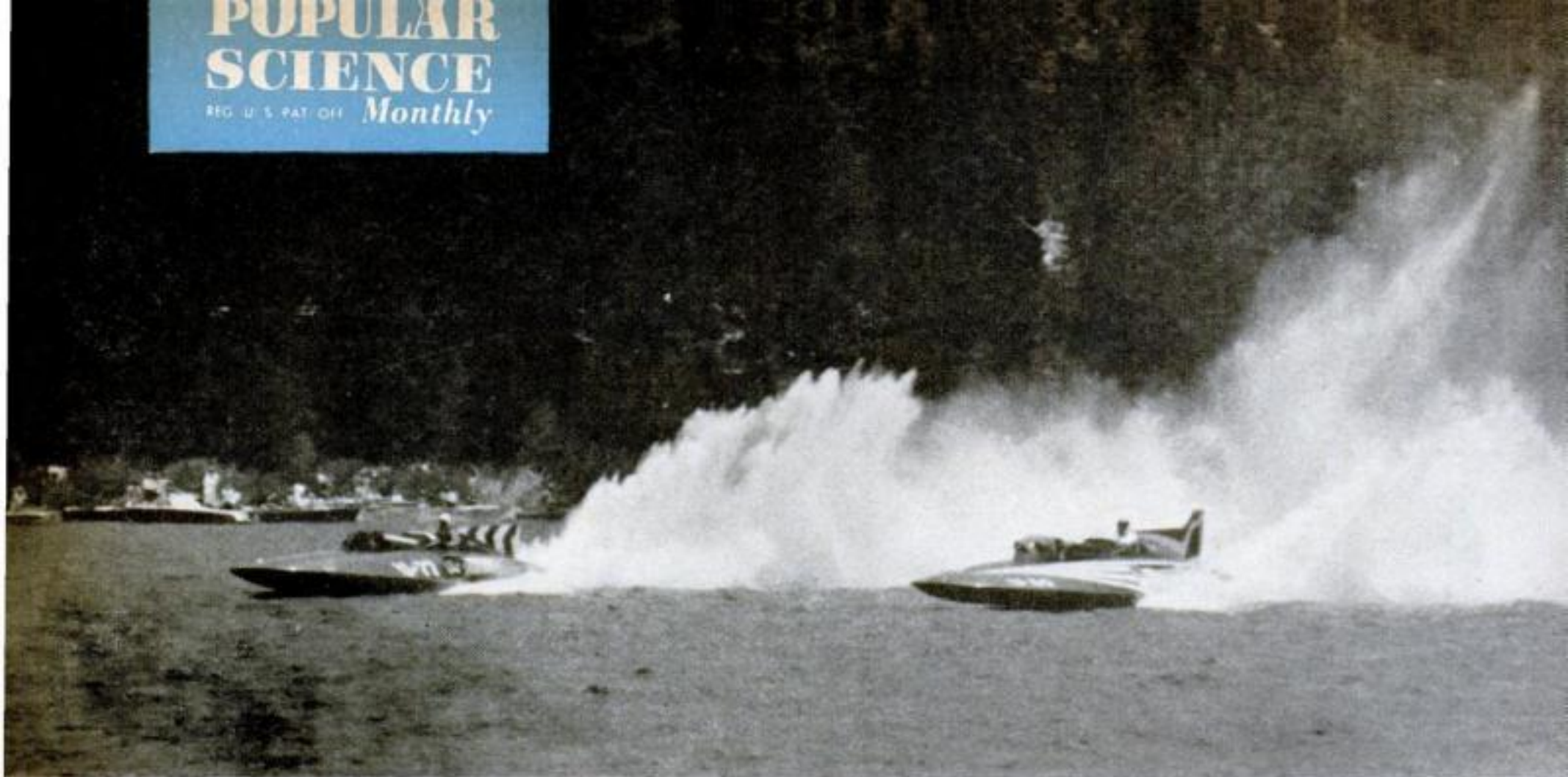
Electric Autolite plants was the important factor in this decision, both Ford and GM have had their own alternators developed for some time.



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Rooster tails lifted high, three unlimiteds jockey for best position as they blast into the

***Like driving a race car at full throttle over railroad ties—
that's unlimited speedboat racing . . .***



The Craziest Sport in the World

By Hank Wieand Bowman

GOLD CUP is trophy for most important event of Unlimited Class season.

ON A sheet of blue water where Indians once canoed, the world's hairiest speedboat race will take place late this month. The Gold Cup race, to be run on Nevada's Pyramid

Lake, will attract the largest and meanest hydroplanes in the world.

They'll fight for supremacy over a 90-mile distance, divided into three 10-lap heats. Their pilots, highly skilled and nervous, will be well aware that they are driving some of the most unstable and dangerous machines man has ever built.

These water monsters, the rules say,



HAWAII KAI, holder of the world's unlimited flying kilometer mark of 195.329 m.p.h., is shown here leading a class heat. Gold Cup events consist of three separate 30-mile heats. Kai's record speed run was made on Lake Washington, Seattle.



first turn. The balance of the field has been obscured by the heavy, blinding spray.

may have hulls 25 to 40 feet long, weighing a minimum of 3,500 pounds. They may be equipped with any inboard motor or motors, supercharged or not supercharged. But propulsion must be accomplished in or against water by a propeller.

Allisons and Rolls-Royce Merlins or Griffins are currently used. These are liquid-cooled, V-12 power plants originally designed for fighter planes. Today they may be bought at surplus for a fraction of their \$40,000 to \$50,000 cost. The Allisons are rated at 1,710 hp.; the Rolls at 2,360 hp. These figures are minimum, for down a straightaway either can wind up to 2,500 horsepower.

The Rolls power plant, complete with gearbox, weighs 200 pounds more than the 1,650-pound Allison. Rolls are often favored, however, because of their two-stage, two-speed superchargers as opposed to Allison's single-stage one-speed blowers. This, coupled with a water-cool-

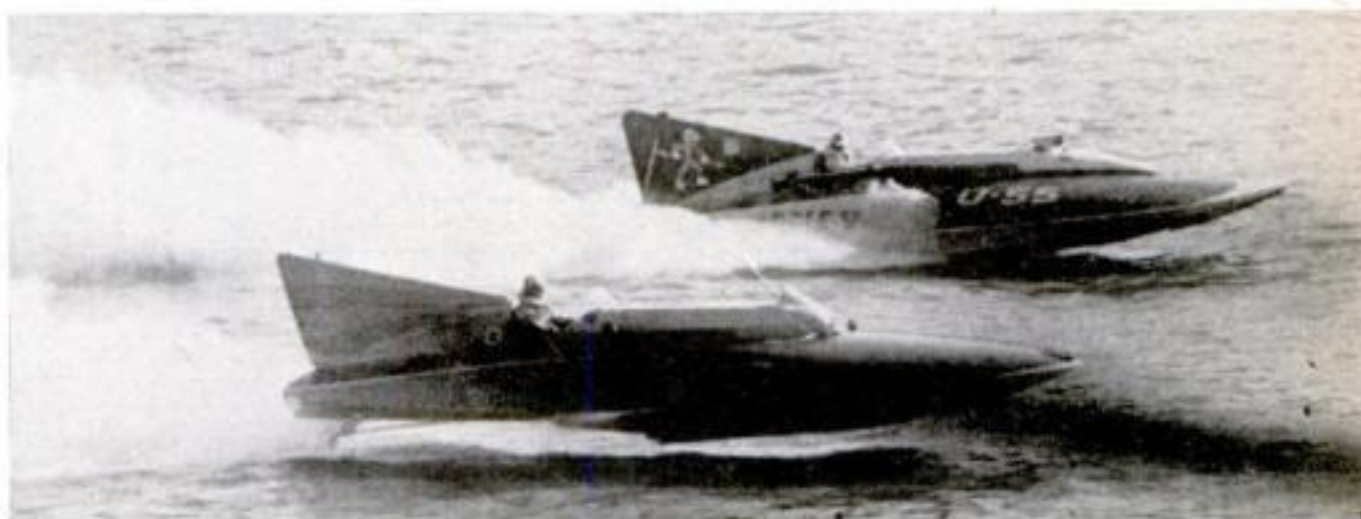
ing jacket on the Rolls blower, gives a cooler, denser fuel charge. To offset these advantages, the Allisons have greater low-speed torque and faster acceleration out of the corners.

Either power plant is awe-inspiring machinery. They can give even veteran Gold Cup drivers pre-race stomach knots and instill respect dusted with fear.

The brute power in these boats may explain why they have attracted more spectators than the Kentucky Derby and the Indianapolis "500" combined. Unlimited Class boats have been clocked on straightaways at speeds around 200 m.p.h. The record for a two-way run over a measured kilometer is 195.329 m.p.h.

Men have died racing them. Orth Mathiot and his mechanic, Tommy Whitaker, were killed in the 1951 Gold Cup race when their hull, Quick Silver, flipped. Many drivers have been seriously injured. The late Lou Fageol, three-time

UNLIMITEDS often soar free of the water as speeds approach 200 m.p.h. Faster than Indianapolis cars, these boats have no brakes and far less steering control. A single Unlimited Class race has attracted as many as half a million spectators.





BREATHTAKING ACTION is provided by two boats sliding through a corner. Sometimes as many

as six boats approach the first corner abreast; stragglers must eat the leaders' spray.

winner of the Gold Cup, had his mount, Slo-Mo-Shun V, become airborne during a qualifying trial in 1954. The Slo shook free of the water, soared 60 feet in air, and performed a back flip.

Bill Muncey, last year's National Unlimited Champion, is campaigning his third Miss Thriftway. The first boat disintegrated in a shower of splinters. Bill was romping down the straightaway at an estimated 150 m.p.h. when a sponson split. Hydraulic pressure blew the boat apart. Two years later he earned the dubious distinction of being the only man to sink a Coast Guard boat since the Spanish-American War. During the Gold Cup at Seattle, Wash., in 1958, the second Miss Thriftway lost her rudder at 130 m.p.h. and knifed into a steel picket craft, sending both boats to the bottom.

Bill Stead, 1959 Gold Cup winner, was forced to bail out of Maverick, which caught fire during a test run. In a replacement Maverick he flipped at 130 m.p.h. in a turn. Colonel Russ Schleehe leaped from a blazing unlimited hydro, suffering severe leg burns and a back injury. Mira Slovak flipped in the same race and was pulled from the water nearer dead than

alive. Oddly, none of these men, even veteran Bill Cantrell, who has had more stitches than a baseball, have quit the sport. All of them say they are often afraid of their power-packed hydros.

Bill Muncey admitted to me that during his record-breaking run through a measured mile he was literally terrified. He screamed when his boat momentarily topped 210 m.p.h.—but he didn't let up on the throttle.

The men who race these boats don't do it for financial gain; they could make more money peddling newspapers. Not a driver I know has a real answer to why he races speedboats.

Squeezing into the boat. Here's what it's like to drive an unlimited. The driver's first move is to squirm into a life vest fitted with a buoyant collar designed to float him head up. A webbed harness that fastens between his legs is supposed to prevent the jacket from being torn from his body. Water, at speeds in excess of 80 m.p.h. is as hard as macadam. Even wave ripples tear at a race driver's body and clothing like ridges on a gigantic wood rasp.

The driver next dons a helmet that, unlike aircraft and auto crash helmets, has been designed to withstand the guillotine impact of razor-sharp propellers winding as high as 12,000 r.p.m.

The auto-race driver wears a safety belt to keep him from being thrown from the car. The speedboat pilot prays that in a crash he will be thrown free. Otherwise he might be pinned under a cap-sized boat and drown before rescue.

The driver's seat in an unlimited is shaped differently from that in a racing car. The sides of the cockpit are contoured. The driver wedges himself into a

COAST GUARD COPTER rescues badly burned driver Don Wilson. Broken fuel line sprayed blazing fuel into cockpit. Wilson was temporarily trapped by snagged life-jacket strap.



seat that is narrower at his rib cage than at his buttocks. A triangle of support in back helps keep him from being catapulted when the boat bucks like a bronco with a burr under its saddle. He presses his back against the rear of the seat, his hands grip the steering wheel with arms stiffened, and his left foot braces on the floor; his right toes the throttle.

There's no neutral. When the engine grabs, the boat is in motion. The first few times a driver hits the starter the engine will cough, splutter, and die. A carburetor fire at this stage is commonplace, but a driver learns not to panic. He tries the starter again, and as soon as the big engine thunders into action, suction of air through the carburetors gulps the flames like a carnival fire swallower.

At low speed the boat wallows like a tug. As the accelerator is further depressed, the engine belches heat and flames, the bow lifts in the air, and the stern mushes. Visibility is temporarily cut off by the 12-foot foredeck that looms in front like a billboard. Gradually two tons struggle onto the surface of the water. Unlimiteds come onto plane at about 60 m.p.h. and hold their plane at about 45 or 50.

The forward section of an unlimited hull is far broader (by about 3:1) than the stern. In its three-point suspension, there are two planing surfaces forward, separated by an air tunnel, and one aft. At high speed an unlimited moves with a slight dancing motion, waltzing from one foreplane to the other, supported by about 2½ square feet of planing surface on the two forward sponsons. The air tunnel gathers air, lifting the single planing surface aft.

At about 90 m.p.h. an unlimited rides on 1½ square feet of surface aft. As speed increases, the stern continues a gradual lift until, under perfect water conditions and at speeds of 130 and higher, the tail section of the boat rides entirely free of the water. The stern is actually supported by one of its two spade-shaped propeller blades.

Lots of action. As soon as the boat is on plane the driver begins his fight against propeller torque. Brute strength is needed; there is no power steering in speedboats. The driver pushes hard upward with his left hand and arm, drags

[Continued on page 168]



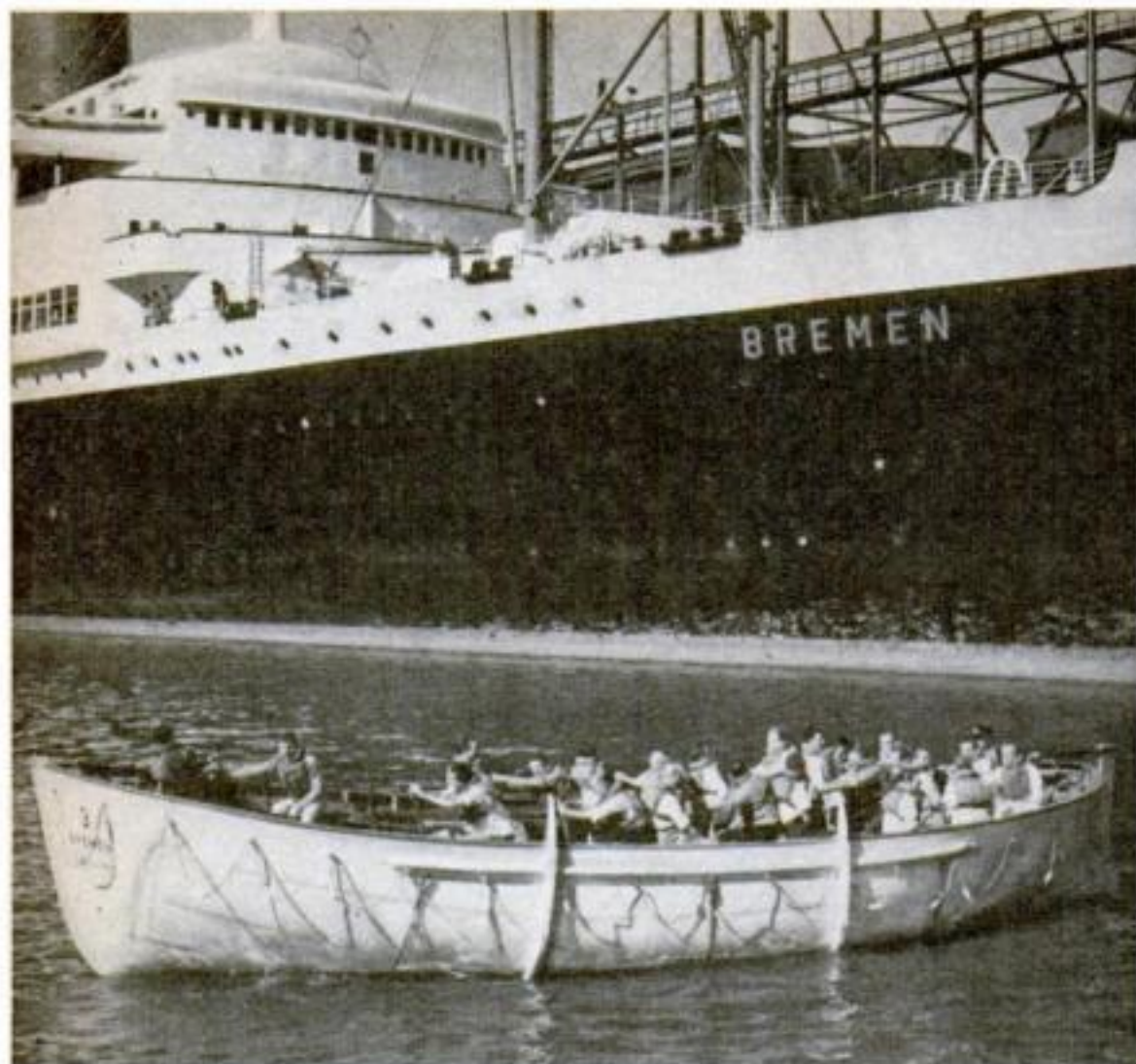
MASSIVE HULLS, weighing more than 1¾ tons, are launched and lifted out of the water by cranes. Here Bill Boeing Jr.'s Wahoo is being lowered. Mira Slovak does the driving.



COMPACT COCKPIT of a typical unlimited has lots of gauges and dials, not much else. Bucket-seat sides curve inward at the waist to keep the driver in place during bumpy ride.



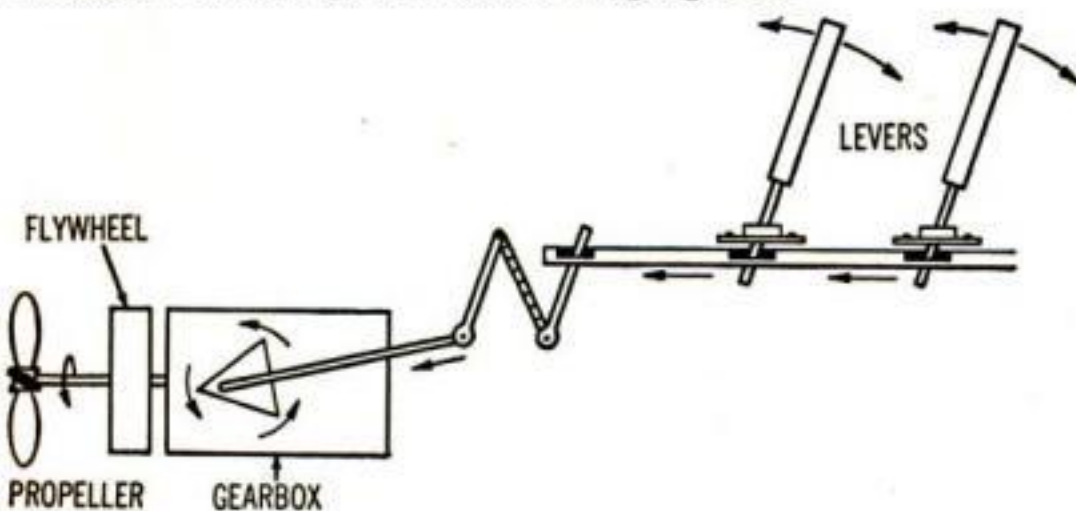
ENGINE SWAP is made during time trials on Miss Thriftway, 1960 unlimited winner. The 6,000-pound boat, powered by Rolls-Royce engine, set flying-mile record of 192.001 m.p.h.



UP THE RIVER WITHOUT A PADDLE—Bremen crew takes part in an abandon-ship drill on New York's Hudson. Boat's top speed is six knots.

SEESAWING CREWMEN, facing fore and aft on "rowing bench," work one of the levers. Oars could be used if the propeller system failed.

TURNING FLYWHEEL to starboard with the foot starts boat moving forward. Each row of levers is connected to a separate "drive shaft." Torque follows arrows along linkage, through gearbox, and to propeller.



Oarless lifeboat

Lifeboat crews aboard the German liner Bremen row without oars. Two banks of levers, six to a side, power a stern propeller through an ingenious linkage and gearbox. Two crewmen alternately push and pull each lever.


The German-made Fleming lifeboat is $27\frac{3}{4}$ feet long and $13\frac{1}{2}$ feet wide. It can hold 41 crewmen and 105 passengers. North German Lloyd line has equipped the Bremen with 10 of them and four motor lifeboats.

Roll bars make Army trucks safer

Heavy steel roll bars are now installed on the front bumper and behind the cab of canvas-roofed Army trucks at White Sands Missile Range, N. Mex.

On a tryout on graded roads that wind the 100-mile length of the range, one of the safety-equipped trucks was pushed at high speed over an embankment. Neither the vehicle nor a belted-in dummy was damaged.





ONR X 40 RAVEN 1
ONR US NAVY

**Gas Flame
Lifts New**

Hot-Air Balloon

*Twirl a knob, and up you go—in a modernized
version of the earliest kind of flying craft*

By Alden P. Armagnac

A 40-FOOT balloon shaped like a plump radish promises sportsmen a new, inexpensive way to fly for fun. It will carry one man on a four-hour aerial jaunt.

If you can boil an egg, you can pilot it. With a little round handle—its principal control—you regulate a burner like one

CONTINUED



PILOT, flanked by propane-gas fuel tanks, sits in swing seat suspended below open bottom of

new balloon. Controllable burner, just above his head, heats air in bag during flight.

on a kitchen range, scaled up in size.

Turn up the bottled-gas flame, and up you go. Lower the flame, and down you come. It's as simple as that.

For this is a hot-air balloon, 1961 style. Its principle goes back to the "fire balloons" that bore aloft the first aeronauts nearly 200 years ago—but modern refinements make it the last word in ballooning.

So far, two of the craft have been built and successfully tested in trial flights over Nebraska and South Dakota. They're for the Navy—which is interested in them for training its high-altitude balloon pilots.

Now their maker, Raven Industries, Inc., of Sioux Falls, S. D., is eyeing their possibilities for sport. This leisurely and pleasant way to sail through the air on a Sunday afternoon, Raven believes, might appeal to private flyers and others with a taste for adventurous pastimes. If further trials confirm that the balloon

is safe enough, and the company finds a sufficient market awaiting the craft, it may soon make its public debut.

The new hot-air balloon, which Raven calls the Vulcoon (from Vulcan, mythical god of fire, plus balloon), has a laminated skin of fabric and plastic. The nylon fabric provides strength; a film of mylar plastic slows leakage of hot air through the otherwise porous nylon.

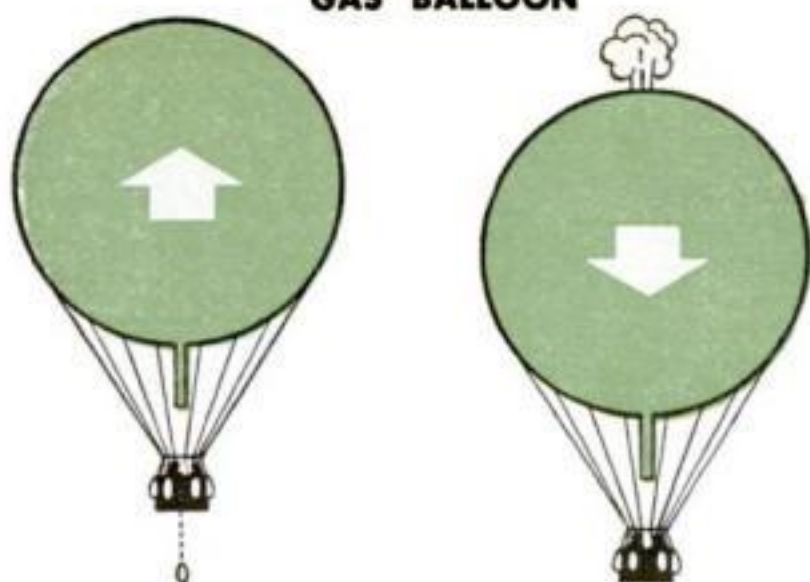
When this 30,000-cubic-foot envelope is filled with hot air at 130 degrees above the outdoor temperature, it will lift a gross load of 450 pounds.

Cooking with gas. The balloon's bottled-gas burner, mounted within its open bottom, heats the air in the bag continuously during a flight. Two propane-gas tanks supply its fuel. A fireproof skirt of glass cloth (or, alternately, of asbestos) forms the lower part of the balloon envelope surrounding the burner.

You sit in a swing seat with a backrest, suspended below the balloon, with

How to control a balloon's ups and downs: old and new ways

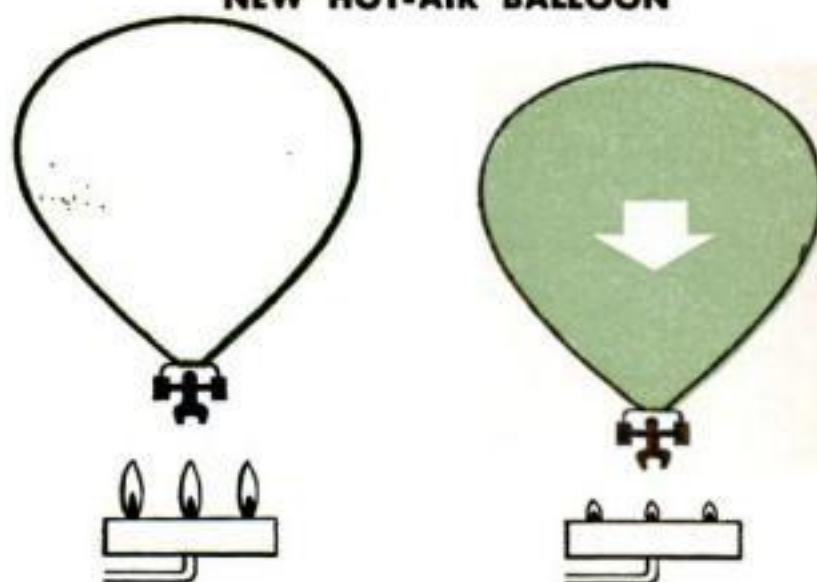
GAS BALLOON



SAND BALLAST goes overboard to lighten balloon for ascent.

VALVING-OFF GAS reduces buoyancy of balloon for descent.

NEW HOT-AIR BALLOON



TURNING BURNER UP increases lift of balloon, to go up.

LOWERING FLAME decreases lift, to bring balloon down.

your feet on a trapeze bar. Your control knob, for ascent and descent, turns the burner flame up or down by regulating a needle valve in the fuel line.

Another control you have at hand is a "quick-override" button. Pressing it bypasses the needle valve, and kicks the fuel supply wide open. The burner flares up and provides a speedy boost—to lift the balloon over an obstacle you're nearing, or to check an over-rapid approach to earth.

Easily carried to a launching site, the Vulcoon can be readied for flight in 35 minutes, including the time to unpack it and lay it out for inflation. First you fill it with air a little warmer than the atmosphere, using a small portable blower and a burner like the balloon's own. When the balloon has filled out and lifted itself, you swing its own burner into place and light it. A small ground crew, of only two or three, suffices for a launching.

To end a flight, you turn down the burner so that the Vulcoon slowly settles toward the ground. At about 80-foot altitude, you shut off the burner completely—a safeguard against fire in the event of spilling or rupturing a fuel container in landing. Just at touching down, you flick a switch that opens a deflation port in the top of the balloon by firing an electric squib. (A safety cover prevents touching this switch accidentally, in flight.) The hot air rushes out and the envelope collapses, to be repacked and taken home.

Advantage: economy. Because its skin is rugged enough to withstand dozens of

handlings without damage, a major feature of the Vulcoon is that you can fly it over and over again. It needs no expensive gas for inflation—the air is free. And its fuel costs only a dollar an hour.

So a Vulcoon is attractively inexpensive to operate during the pilot-qualification tests that the Federal Aviation Agency requires for a free-balloon pilot's license. And its economy should likewise appeal, Raven suggests, to those interested in ballooning for sport.

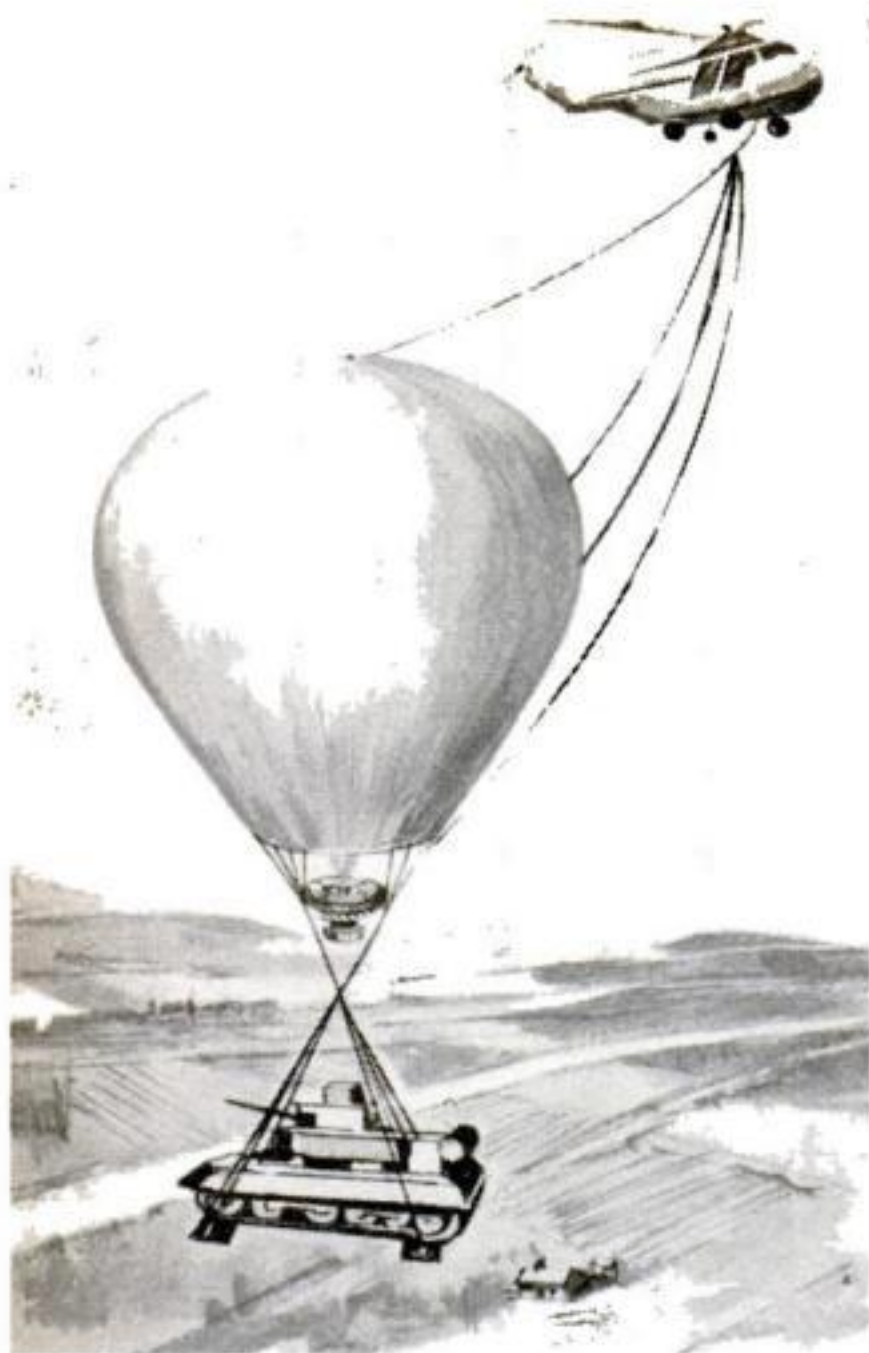
Most novel of its advantages, however, is its ease of control—since you can vary its buoyancy so flexibly and precisely by regulating its burner. Why this is important is easy to see:

The whole art of piloting a free bal-

CONTINUED

ON LANDING, pilot fires electric squib that opens deflation port in top of balloon as shown. Hot air rushes out and bag collapses.





FOR CARGO CARRYING, scaled-up military version of new hot-air balloon is being considered by Navy. A 3,000,000-cubic-foot balloon, towed by helicopter, could lift 15 to 20 tons.

loon consists of maneuvering it to the right level, where a favorable wind will take you the way you want to go. So the principal problem of ballooning is how to alter the craft's buoyancy in order to ascend and descend at will.

A gas balloon, the rival of the hot-air kind, has to make do with a comparatively crude solution. Inflated with a lighter-than-air gas—originally hydrogen, but nowadays safer, fireproof helium—it starts a flight with its maximum buoyancy. Thereafter its lift can only diminish as its gas slowly leaks away.

Ups and downs. To check its settling and go up again, the pilot of a gas balloon must toss overboard sandbags or loose sand. To reduce his altitude, he must sacrifice irreplaceable buoyancy by releasing some of the lifting gas—and then, to end the descent, jettison more sand ballast. His supply of ballast sets the limit for the duration of his flight.

With a hot-air balloon, there's no dropping of ballast or valving-off of pre-

cious gas. In theory, its ability to manufacture its lift in flight should be a decisive advantage. But the early hot-air balloon, whose primitive burner was a brazier fed with bundles of chopped straw, was far from a practical embodiment of this alluring theory. Not surprisingly, the gas balloon outmoded it—and the U. S. Navy, an old hand at ballooning to train its blimp pilots, has been using helium balloons. The hot-air balloon's comeback has awaited the modern developments combined in Raven's Vulcoon: liquid fuel, and a burner with dial-like control, as well as a lightweight and strong synthetic skin.

Modernizing the hot-air balloon represents more than six years' work by Paul E. Yost, who began exploring the idea while at General Mills, Minneapolis, under an Office of Naval Research contract. Later, at Raven, he became manager of a project to develop the Vulcoon for ONR. He test-piloted the first two Vulcoons.

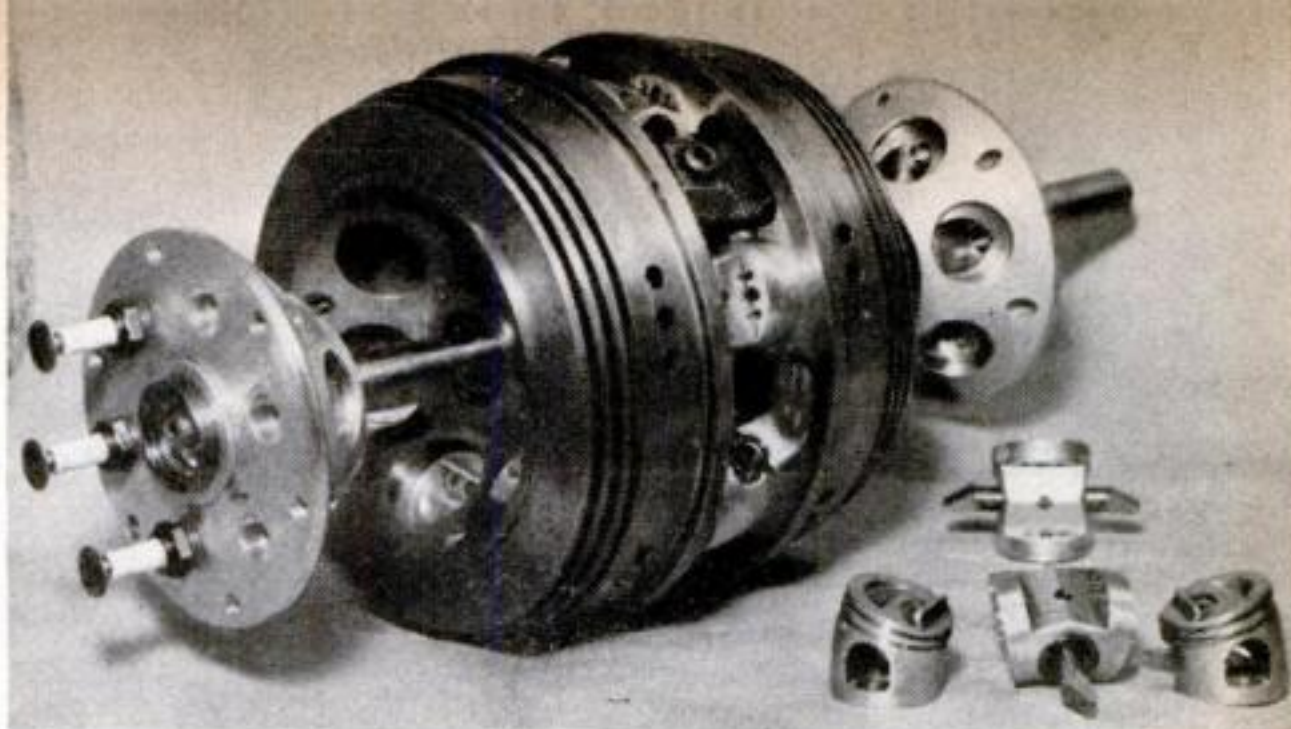
In the first trial flights, Yost has ridden the Vulcoon to 9,000-foot altitude, climbed as fast as 1,000 feet a minute, and, by cutting back on the fuel setting, descended for a landing at less than 500 feet a minute. By turning up the burner while the balloon was falling nearly 900 feet a minute (10 m.p.h.), he was able to stop it within 300 feet.

Bigger ones to come? Possibly the first of a whole new family of hot-air balloons, the Vulcoon may get a big brother. Currently the Navy is considering military applications of a scaled-up version, of the same shape, materials, and general design, for "construction, transport, and supply operations."

A 3,000,000-cubic-foot hot-air balloon, for example, could lift and support in mid-air a load totaling 15 to 20 tons. Then a helicopter could tow the balloon and its cargo to a distant destination.

For use as a heavy-cargo lifter in this fashion, the hot-air balloon could be unmanned and operated by remote control. Cast loose with burner turned down, it would descend gently to earth to deliver its load. At touchdown, an impact switch would automatically cut off the burner and open the deflating port, grounding balloon and cargo. Like the smaller Vulcoon, this giant version could be used repeatedly. ■ ■

SIMPLE CONSTRUCTION of first version of rotating-cylinder engine is laid bare in disassembly. From left: spark plugs with wiper-contact tops; cylinder head; two halves of block, each with six curved cylinders. At lower right—laid out in a row—are the three segments that make up one sausage-shaped piston.



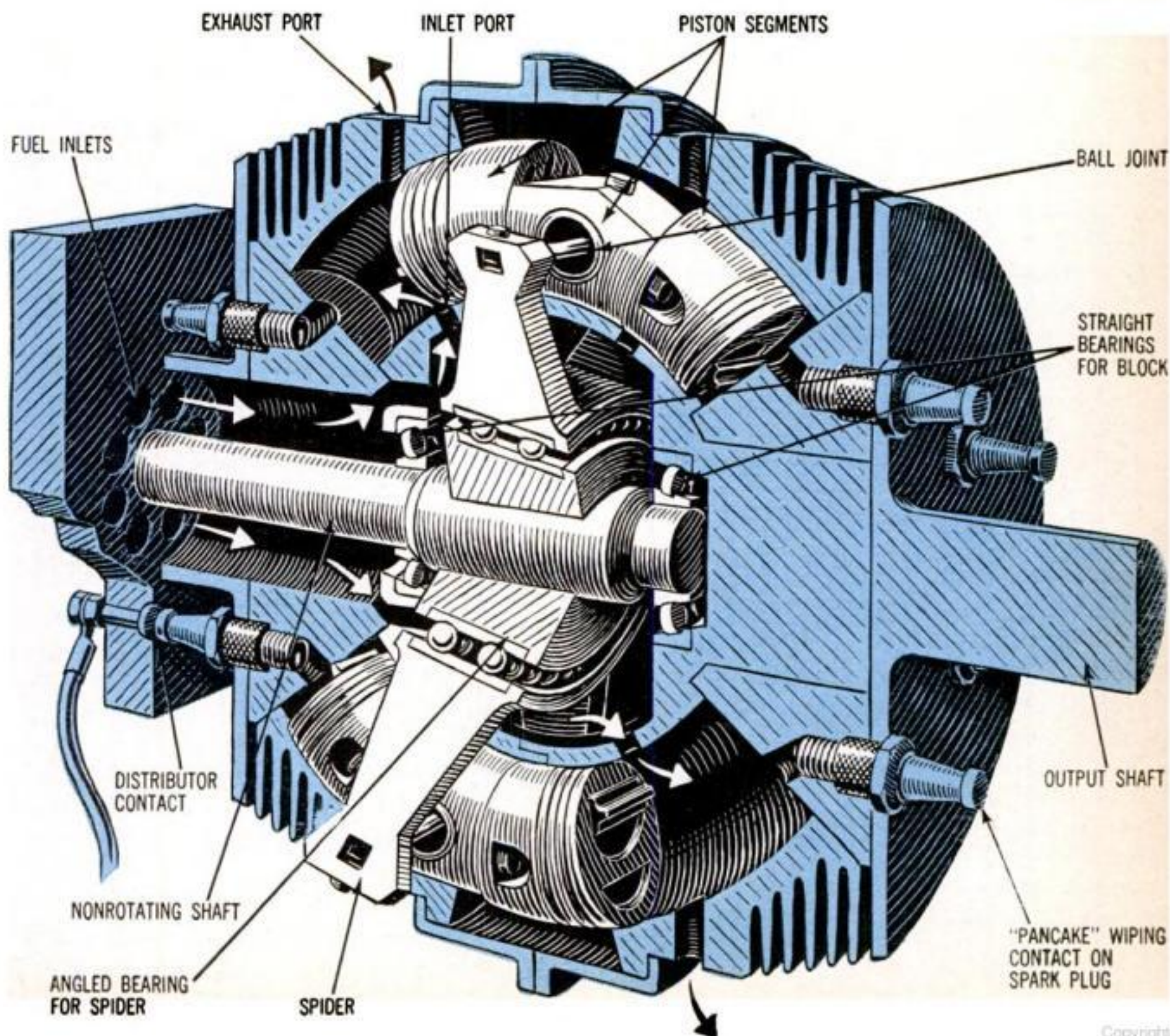
Rotary Engine Fires Like a Six-Shooter

Both pistons and cylinders spin in this radical new power plant for autos and lightplanes

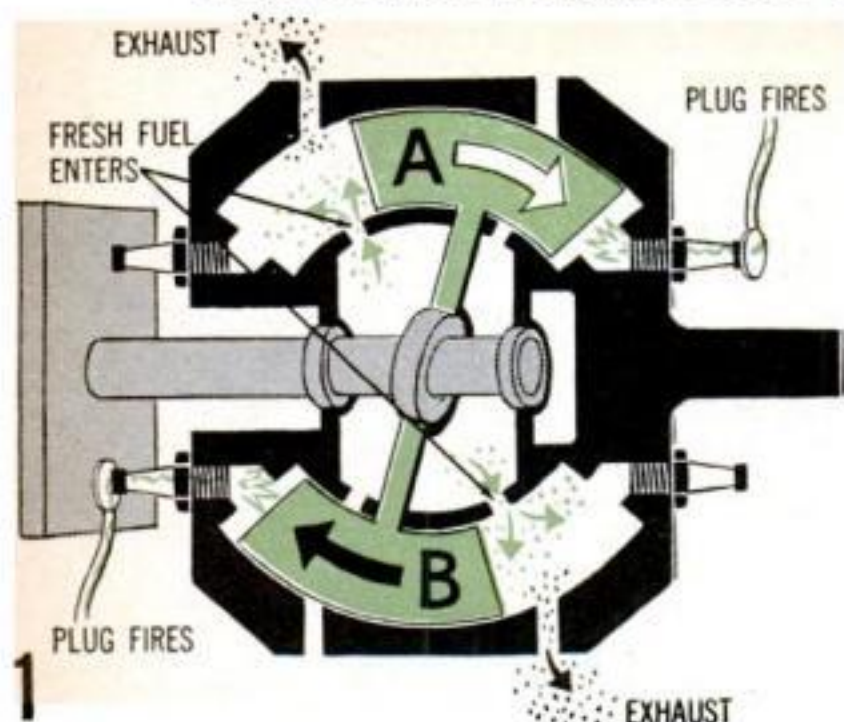
By David Scott

IT LOOKED like a lump of metal impaled on a spit. An elderly man in a beret and white coat wrapped the starting cord around one end and gave it a jerk. Exhaust crackle filled the tin shed. Engineers from Ford, Rolls-Royce,

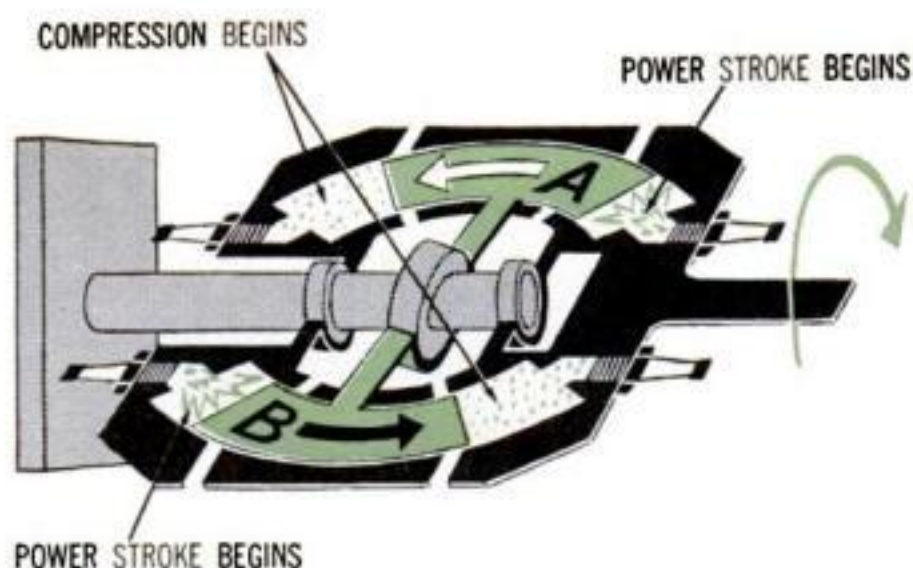
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The action is pure two-stroke, like any outboard motor—yet

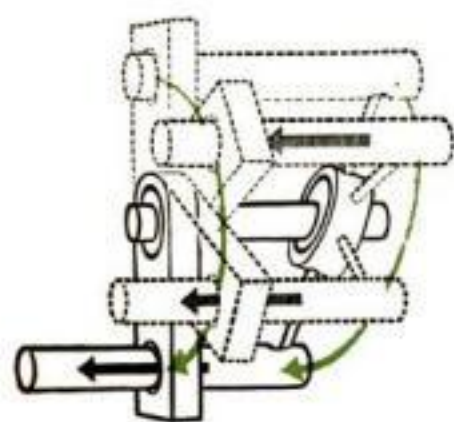


HOW IT WORKS: These drawings follow an opposite pair of pistons through half of one complete revolution of the engine. Diametrically



2

opposite plugs fire at the same time (1) to balance forces. At the other end of the cylinders, fresh fuel enters while spent gases exhaust. Ex-



RECIPROCATING effect is achieved by spinning parts at an angle. There is no true back-and-forth motion, yet parts shift back and forth relative to each other. Swash-plate engine uses same idea, but only to replace crankshaft.

Bristol-Siddeley—the cream of Britain's auto-aviation society—sat up for a better look.

This was the rotating-cylinder engine invented by spry, sharp, 64-year-old Cecil Hughes, and unveiled at a private demonstration near Southampton. Both its pistons and its cylinders spin in circles. Nothing reciprocates—but the pistons *seem* to.

Have your cake and eat it, too. Because the pistons, in effect, move back and forth within the cylinders, you sidestep all the problems of sealing and timing that afflict most rotary engines. But because there is no genuine back-and-forth motion, you eliminate vibration and wear as neatly as any rotary does. Hughes' engine combines the thermodynamic efficiency of the present internal-combustion engine with the vibration-free, high-speed advantages of the turbine.

Some experts consider this radical power plant a natural for cars and helicopters. It has 12 cylinders that deliver 12 power impulses per revolution.

Smoothness and low-speed torque equal those of a 12-cylinder four-cycle engine.

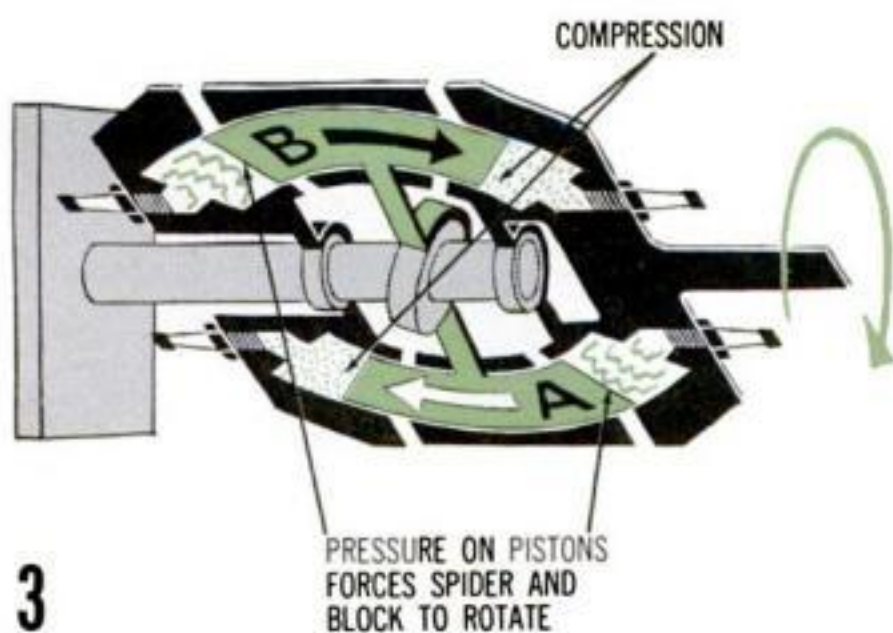
The halved block. The cylinders are bored into a drumlike block. But the block is sliced into two drums, making two opposed sets of six cylinders. Think of the revolving magazine of a six-shooter sawed across the middle and the halves pulled apart, and you have it—except that these holes are curved.

Fitting each opposed pair of cylinders is a double-ended piston, sausage-shaped and segmented. There are no piston rods or crankshaft. The center segment of each piston is connected through a ball joint to the end of the spoke of a spider—the hookup is similar to the Dipsy-Doodle at an amusement park.

The spider creates the effect of reciprocating action without really reciprocating anything. Both it and the cylinder block rotate freely around the same stationary shaft. But the spider is mounted at an angle (15 degrees), while the block is set square. As they spin together, the ends of the spider (and the pistons there) move relative to the block. (The action resembles that of a swash-plate engine [PS, Mar. '58].) That is, the pistons do slide in and out of the cylinder bores. But this back-and-forth motion is only relative to the block. The pistons never actually reverse their direction, so reciprocating motion and its drawbacks are totally eliminated.

Harnessing the horses. If you're wondering how they get power out of this thing, there's an output shaft fixed to

all the machinery spins like a turbine



3

ploding fuel (2 and 3) tries to push pistons along cylinders, but they can move in that direction only by spinning (out of plane of pa-

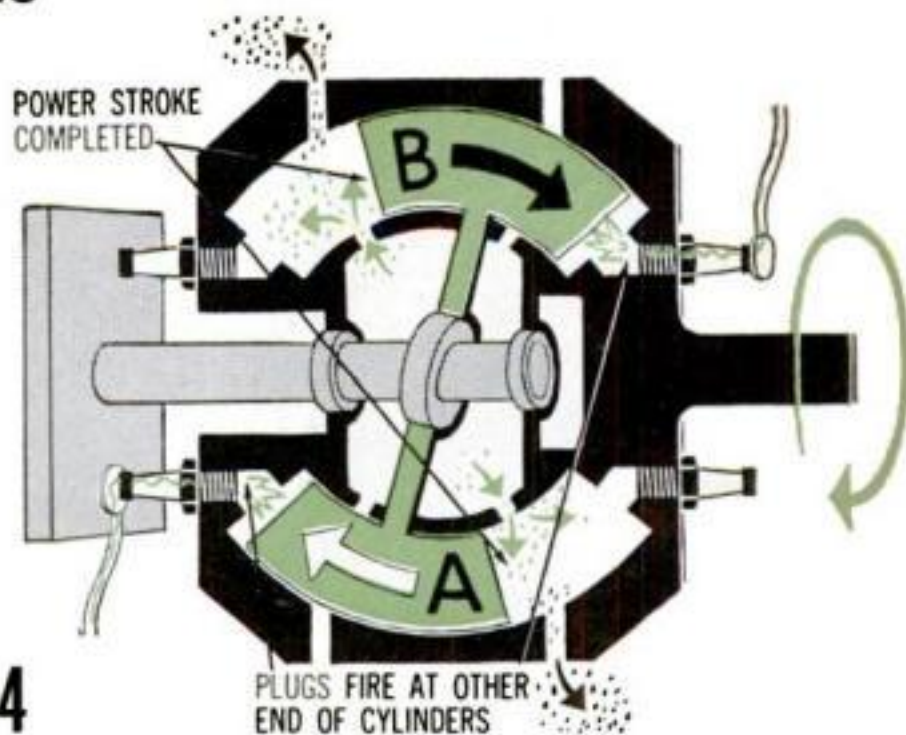
one flat side of the drumlike block. In operation, each explosion pushes the piston "forward"—along the cylinder axis. But the piston can move forward only by going "sideways"—around the spider orbit. That pushes the cylinder block around.

Hughes' invention is a wild one in other ways. Naturally, the engine is its own flywheel, with that heavy block spinning constantly.

But on top of that it is its own distributor. The six spark plugs screwed into each side are topped with pancake-like terminals. Each plug fires when its pancake wipes across a stationary contact, one mounted on each side. These electrodes are diagonally opposite each other, so diametrically opposed cylinders fire simultaneously. This prevents unbalanced loads on bearings.

Then there's the supercharger. In an ordinary two-stroke engine, the undersides of the pistons sweep fuel and exhaust through the crankcase. This job is a two-stroke, but its pistons have no undersides, just two heads. The prototype uses a Roots blower to pump in fuel (16:1 gas-oil).

Hughes, an experienced builder of racing engines, claims that his design cuts friction losses by two-thirds. The experimental engine, he says, is "rudimentary, built straight off the drawing board to prove the principle." Yet it worked immediately. During the past year it has run more than 300 hours at speeds as high as 4,000 r.p.m.

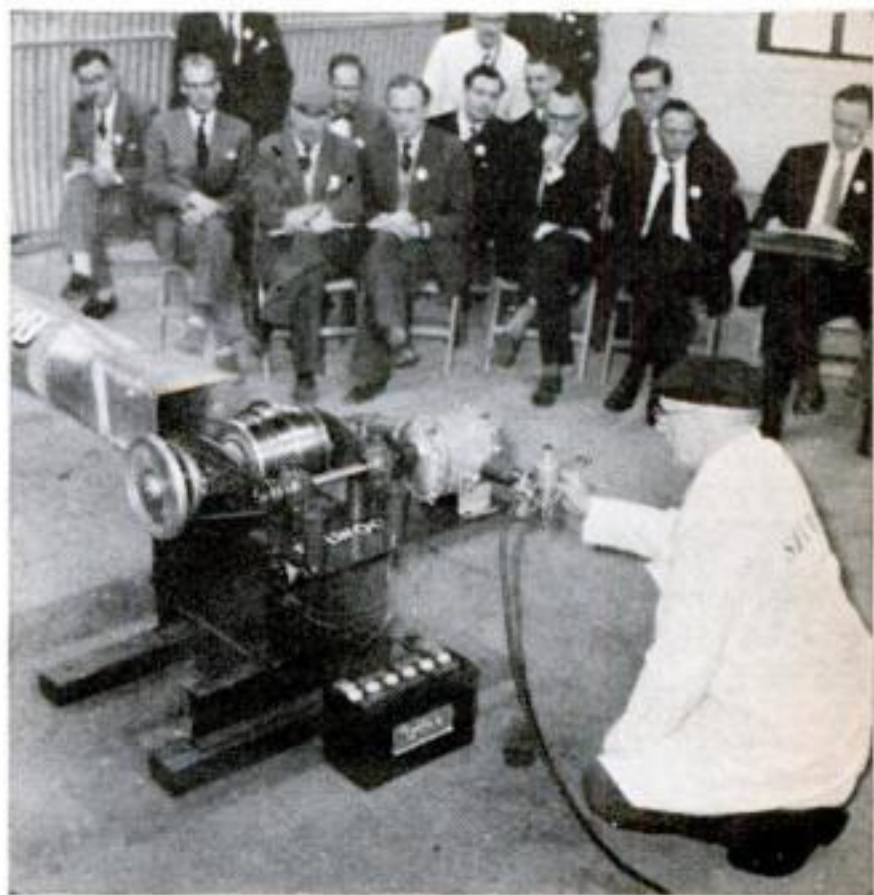


4

per). So pistons and block rotate, shifting relative positions. Completion of cycle (4) brings ignition at other ends of cylinders.

"This 43-cubic-inch engine is capable of 12,000 r.p.m.," Hughes said, "and I could easily pare its weight to 45 pounds. Cylinder bore could be increased to 61-cubic-inch displacement in the same 10½-inch sphere." An engine of twice the bulk would have a displacement of 488 cu. in.—a real whopper. Hughes is also thinking ahead to four-stroke versions, diesels, and dual units back-to-back on a common shaft.

The British auto scouts who witnessed the test run were obviously impressed. Remarked one of the Ford engineers: "I wish I'd thought of that." ■ ■



BERET-TOPPED INVENTOR, Cecil Hughes, fires up his strange engine for audience of industry experts. Hood removes exhaust fumes—Hughes didn't bother with a manifold for prototype.



PLASTIC RESINS are drawn from barrel, to be thoroughly blended in a mechanical mixer.



MIXTURE IS SPRAYED onto mold lined with fiber-glass. It foams to many times its volume.



PANEL IS REMOVED from mold after 45 minutes. It is 3 by 10 feet, weighs 22 pounds.

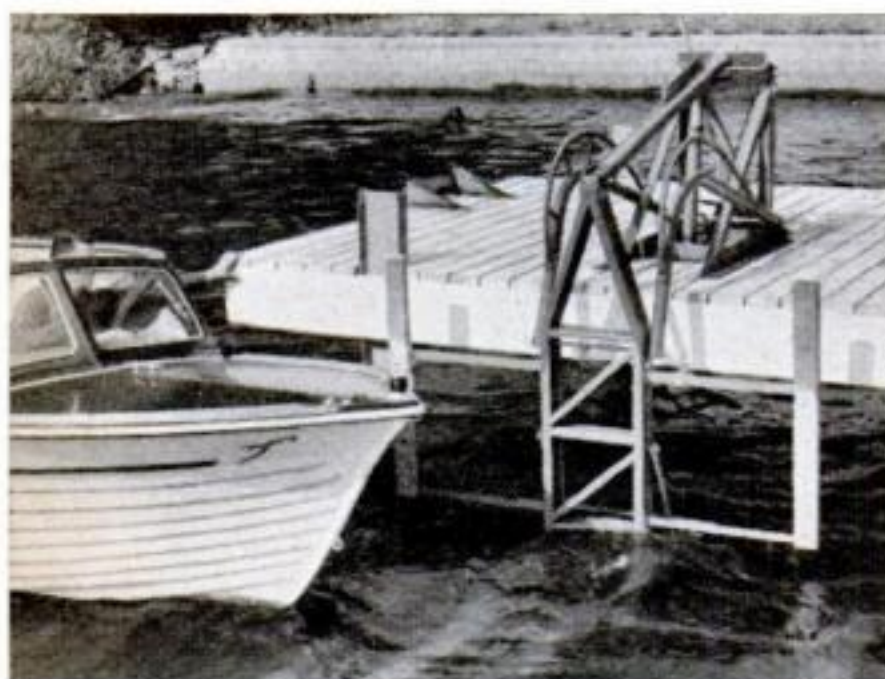
Buildings now come in barrels

Two unusual plastic-foam buildings are being tried out this summer at Camp Century, the Army's city under ice in Greenland [PS, Feb. '60].

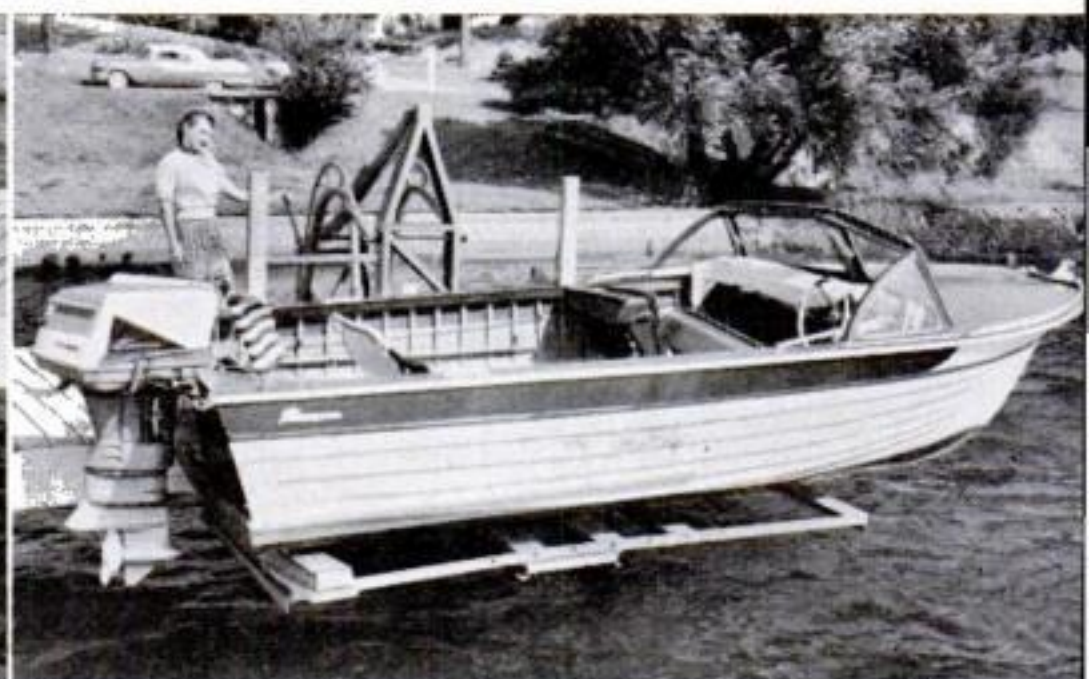
They were made from resins—polyester and polyurethane—shipped to the Greenland icecap in barrels. There they were mixed together and poured into molds,

where they expanded into three-by-ten-foot panels. One 55-gallon barrel of each of the resins is sufficient to make a 16-by-24-foot building 9 feet high.

The material is light, strong, flexible, waterproof, and self-insulating. It's comparatively cheap, too: \$1.50 per cubic foot, or about \$1 a pound.



BOAT IS BROUGHT TO DOCK and maneuvered over cradle shown here lowered beneath surface.

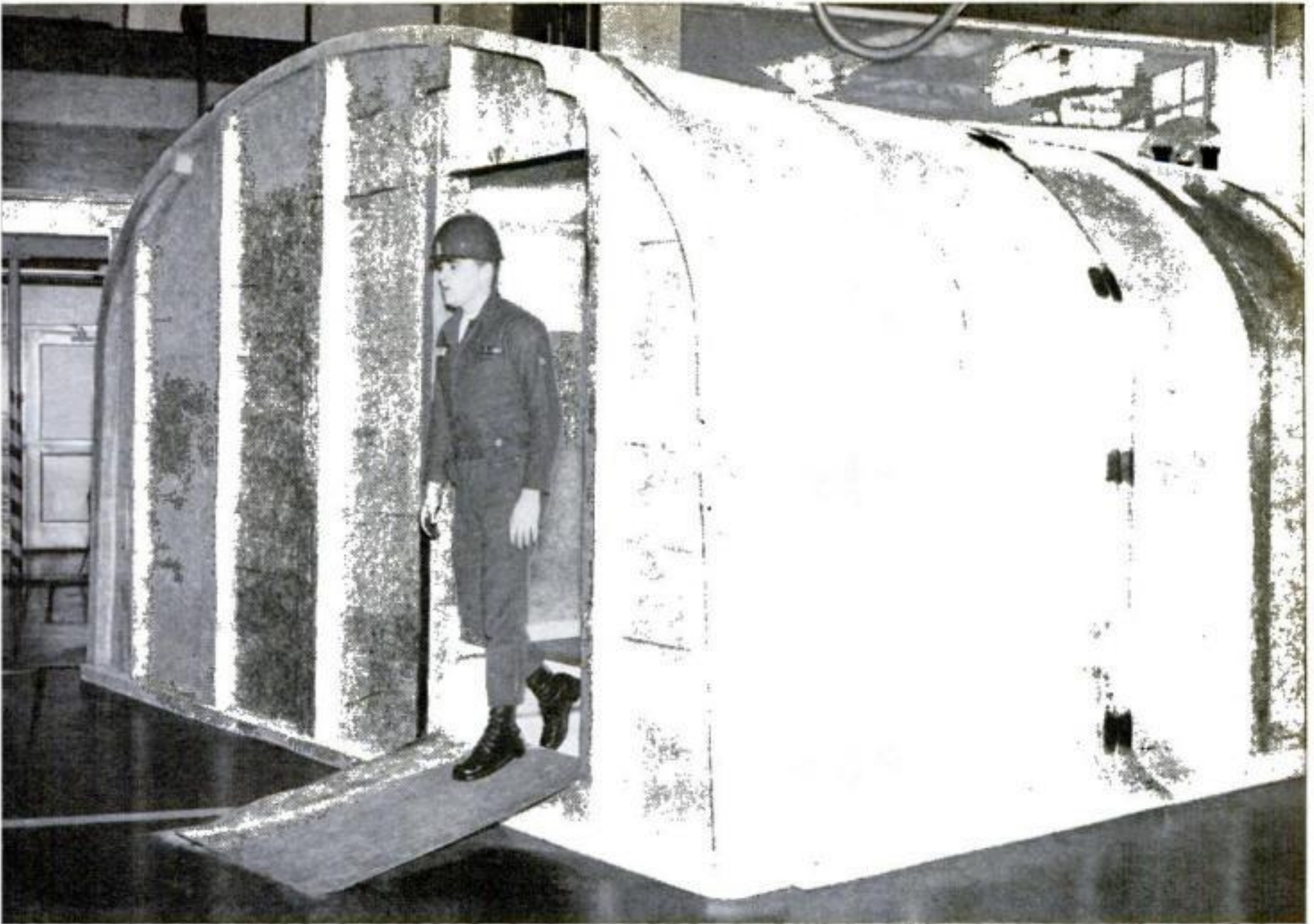


PUMPING A LEVER raises cradle and boat out of water. Safety lock holds them in position.

Hydraulic boat lift

You can dock your boat out of the water quickly and easily with a new hydraulic lift. It consists of a cradle well below the surface of the water and a hoist that can lift a boat six feet. The device

can be mounted at the edge of a dock or a sea wall. Reimann & Georger, Buffalo, N.Y., makes it in three styles: a hand-operated model with a capacity of 1,200 pounds for \$295 (above), a pushbutton electric model for \$420, and an electric one that handles 2,400 pounds for \$595.

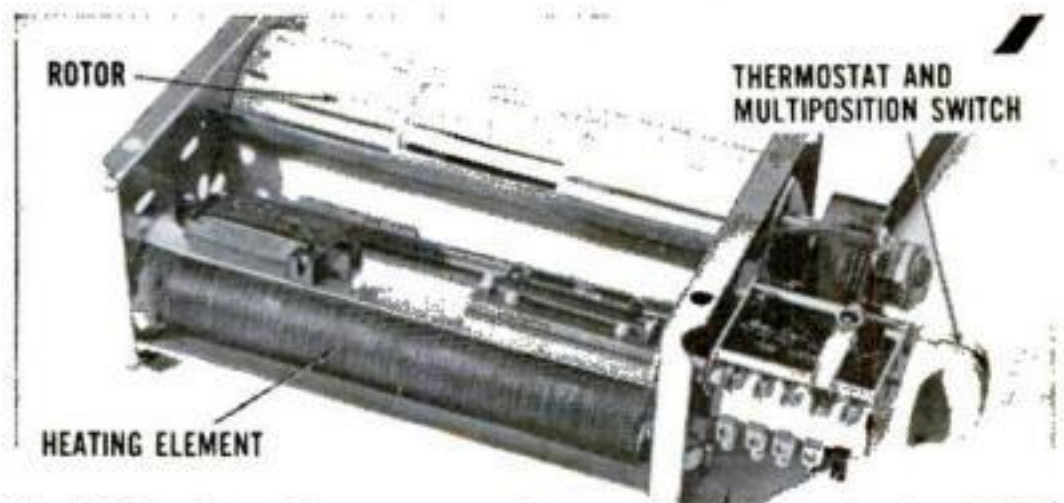


Panels are joined with fiber-glass tape or mechanical fasteners to form sturdy building.



Air is used to move air

A vortex of air, created by curved blades on a paddle-wheel rotor, pulls the moving air stream past at a speed greater than that of the blades themselves in this new "tangential" fan. Result: a powerful, turbulence-free flow of air that is thrown 15 feet before convection (in the case of heated air) breaks it up; and a slow-running—and hence noiseless—motor. The rotor spins inside specially shaped baffles that control the angle at which air enters the fan. The fan shown here was made in England from a German invention.



Air flow circulates around room without drafts. Heart of fan is rotor spinning inside baffles.



READY TO GO: Special Forces "A" Detachment is shown here with all equipment, just as they'd drop behind enemy lines. Gear of executive officer is spread out to show contents. Each man carries a rifle and pistol.

U.S. Special Forces: The Faceless Army

By Everett H. Ortner

IN THE swamps and forests around Fort Bragg, N.C., an army of faceless and nameless men is in training. No photographer may take a full-face picture of any of them, and even profile shots are permitted only when the man's face is in shadow. Their names may not

be connected with their duties. Where they have been no one will say. Where they will go can only be conjectured.

They are the U.S. Army's Special Forces—soldiers; experts in the dark-of-night techniques of guerrilla warfare; above all, teachers.

WEAPONS: Training guerrillas is primary Special Forces mission. Here a weapons expert instructs guerrilla (simulated), at submachine gun.

FIRST AID: Guerrilla gives first aid to wounded comrade as medic stands by. Medic is trained for any emergency—even delivering a baby.



In small numbers, these stealthy specialists have been around since 1952: the 7th Special Forces Group at Fort Bragg, the 10th at Bad Tölz, Germany, the 1st in Okinawa. And some in places that cannot be mentioned. But now they are being augmented. President Kennedy has declared that the world's communist nations will be met on their own ground—subversion with subversion, guerrillas with guerrillas. By the end of next year, the hundreds of Special Forces men will have increased to thousands.

Defending the free world. Obviously, however, the United States cannot protect every national border; nations must defend themselves. "In most areas of the world," says President Kennedy, "the main burden of local defense against overt attack, subversion, and guerrilla warfare must rest on local forces."

How can the United States help? With military teachers—the best trained of any army in the world.

Although Special Forces men can scrap like jungle cats, they will not. They are teach-and-run soldiers. They will never fire a shot at the enemy, never ambush a convoy, never send a bridge in fragments to the sky. Such matters are the subjects of their curriculum. The practice will be left to their students.

"A Special Forces man is too valuable to be risked," says Col. William P. Yarborough, commander of the Special Warfare Center at Fort Bragg and head of the Special Forces. "He must stay alive, to keep on teaching."

To that end, Special Forces ruthlessly eliminates the "gung-ho"—over-reckless—warriors. "No heroes wanted," it proclaims. Says one officer: "We believe in death—but only for the enemy."

DEMOLITIONS: Guerrillas plant TNT under a railroad track, with demo man observing. Other guerrillas cover, to prevent surprise.



MOUNTAINS ARE NO CHALLENGE: Every SF man is a trained climber. His gear includes 120 feet of rope, piton hammer, pitons, heavy gloves.

What makes them special? How do you select men who will, against all American tradition, *not* aspire to the Medal of Honor? Special Forces has a touchstone: maturity. Out go the unstable soldier, the disobedient soldier, the man who can't be counted on to be where he is supposed to be.

About 20 percent of the men now in training for Special Forces will never make it. Some will be rejected for lack of "maturity." Others will prove too gung-ho; or unable to learn or to teach as a Special Forces man must. Or a man may have personal traits that would make him vulnerable to blackmail—dangerous in a security-tight organization. Or he may not be able to get an FBI secret

COMMUNICATIONS: With a guerrilla cranking the generator, a radio man dah-dits his report. Twelve-man "A" Detachment has four radio sets.



CONTINUED

57



**Secrecy—
symbolized by
grilled doors
—is protective
shield of
Special Forces**

BARRED ENTRANCE to S-2 (intelligence) office of 7th Special Forces Group uses a spring clothespin (upper right) to work alarm. Clothespin sets off a buzzer when door is opened.

clearance—the result usually not of disloyalty but of some condition that makes it overly difficult or impossible for the FBI to certify his loyalty.

The man who is accepted for training with Special Forces is, first of all, a volunteer. He is probably a bit older than the average soldier . . . married . . . a trained paratrooper. He has probably been in the Army for some time—perhaps is a sergeant of the upper grades.

In case he thinks he is already expert enough at the soldiering business, Special Forces will change his mind.

Into the dark. He is already a trained parachutist, but that's not enough. He learned to leap into the blue—now he'll learn to leap into the black. All Special Forces jumps are made at night. "It's a cinch when we have enough time—say half an hour—to make several passes over the drop zone," an officer said. "We can drop off a couple of men first and give them time to get to the ground before the rest of us jump. They'll watch for the gear as it comes down, and signal so the rest of us can rendezvous. But it's another story when time is short. Then each man has to kick his gear out of the plane just before he jumps and

watch it to the ground. Tricky stuff at night."

Before he entered Special Forces, the average combat soldier had learned how to fire his basic weapon—a rifle or carbine, usually. He had also learned the rudiments of two or three other weapons: machine gun, mortar, automatic rifle. That's not enough for Special Forces. Here, if he's a weapons specialist, he'll learn how to fire and maintain 14 different U.S. weapons and 27 foreign weapons. He'll know how to shoot, and instruct on, just about any weapon his guerrilla pupils might lay their hands on. That includes bows and arrows.

Throwing out the manual. The demolitions man has some surprises in store, too. The Army taught him all the standard ways to disassemble a bridge or warehouse explosively. That's not enough now. Special Forces will teach him the *unstandard* ways. He'll learn how to use explosives ranging in power from super-secret stuff that makes ordinary TNT look like cake mix, down to homey, do-it-yourself recipes involving pinches of this and that—generally available ingredients that you might have in your own back yard.

Simple first aid is not enough for a Special Forces medical specialist. He'll get 41 weeks of rigorous hospital training. "Our medic is the closest thing in the Army to a real doctor," says an officer. "He can remove an appendix, amputate a leg, or deliver a baby."

The operations and intelligence man will study subjects that would be completely appropriate to the Command and General Staff School. A sampling: Psychological Warfare Intelligence; Prisoner of War Interrogation; Military Aspects of Terrain; Sketching; Collecting and Processing of Information; Counter Guerrilla Training; Mountain Operations. He will become an expert on maps—not only on U.S. military maps but on any maps, anywhere. Special Forces stocks maps from the four ends of the earth. A



DEMOLITIONS TAPE—really two tape reels joined together—gives readings in pounds of TNT instead of inches and feet. One tape is for timber, the other for concrete and steel.



INFRARED LAMP sends dark-of-night signals that can be picked up only with special goggles. Hand key (foreground) is for code. Cord runs back to power pack: five flashlight batteries.



FOREIGN WEAPONS are fired routinely by Special Forces men. These submachine guns, photographed at range, are: German Schmeisser, Russian PPSH, and (best liked) Finnish Suomi.

good operations man knows the symbols for a second-grade road or a telegraph line or a church on almost any of them.

The communications man will learn to operate his radio—and keep it operating—under almost any conditions. No spare parts? A short? He'll have no higher-headquarters repairman to call on. *He's* the repairman.

Combining the skills. The basic operating unit of Special Forces is the "A" Detachment, a self-sufficient 12-man team. It has two officers and 10 enlisted men—two for each of the team's five military specialties: operations and intelligence, demolitions, medical aid, communications, and weapons. In the field, at the commander's discretion, the detachment can be neatly divided into two six-man teams, each also complete. Or it can be augmented—with extra specialists, higher-ranking officers—to become a B or even C detachment.

It is to one of these A Detachments that the newcomer to Special Forces is assigned when he has completed his orientation training and has received his

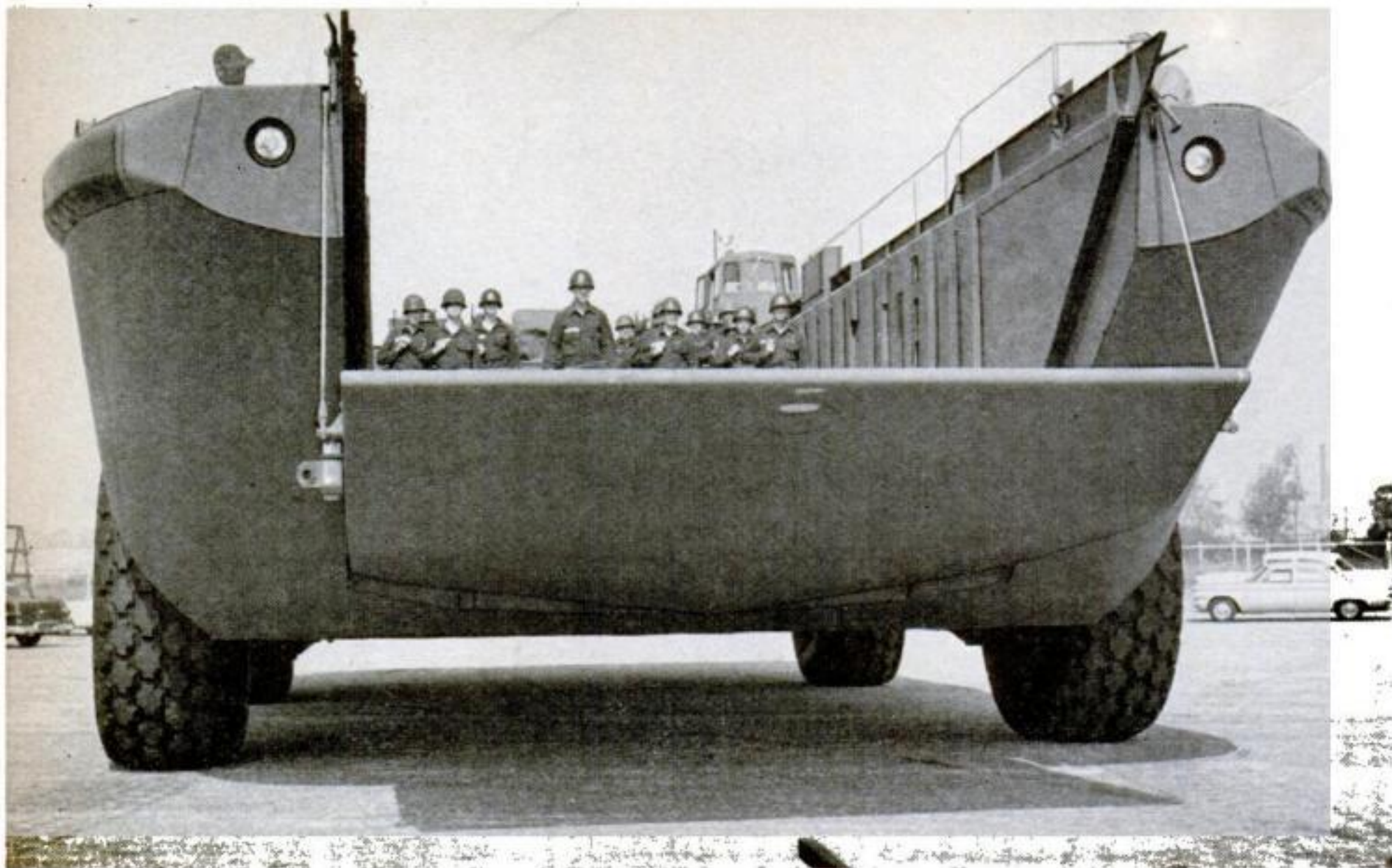
security clearance. In most cases, this will be his permanent assignment—through training and in operations.

Here he completes those courses that make him a specialist. But that's only a beginning. He's got to be a subspecialist, too. So now he's started off on his "cross-training": three weeks each in three of the other four specialties. This is insurance. In the field, no detachment will ever be lacking a critical skill. If something happens to the two communications men, on average six of the other eight enlisted men will be able to operate the radios—and that includes sending

[Continued on page 172]

RAPPELLING TOWER, 33 feet high, is used by Special Forces to teach trick for coming down a mountain fast. Rope, secured at top, passes through snap link tied to climber. Feet flat against wall, climber lets rope slide through link at controlled rate, and eases his way quickly to the bottom.





IMMENSE SIZE OF BARC can be judged from this end-on view. Ramp at the bow is watertight

when raised. Interior is large enough to accommodate a 38-foot-long railroad locomotive.

Mighty BARC at home on



TROOPS MARCH ON over lowered ramp at demonstration of one of latest six models of BARC. It was held at Terminal Island, Calif.

The world's largest amphibious vehicle, the U.S. Army's 60-ton BARC is a massive troop and supply transport. It carries in its cavernous maw 100 tons of tanks, guns, crawler trains, or fighting men— $1\frac{2}{3}$ times its own weight—ready to disgorge them on an enemy's shore.

The BARC (for Barge, Amphibious, Resupply, Cargo) is 62 feet long, 27 feet wide, and 20 feet high, with a cargo compartment more than 38 feet long, 14 feet wide, and $5\frac{1}{2}$ feet deep. It's powered by four 200-hp. diesels—one for each of its giant wheels on land, two to drive each

DETACHMENT DEBARKS at right from an earlier model at Fort Eustis, Va. These have pilot house at forward end instead of at stern.





COMING IN FOR A LANDING, one of Army's BARCs rolls to shore. This one was delivered on Taiwan for U.S. team training Chinese Nationalists in modern methods of military supply.

TWO BIG ARMORED VEHICLES drive off ramp: a 40-ton M-48 tank with 90-mm. gun and a 25-ton M-42 motorized gun carriage with twin 40-mm. guns.



land or sea

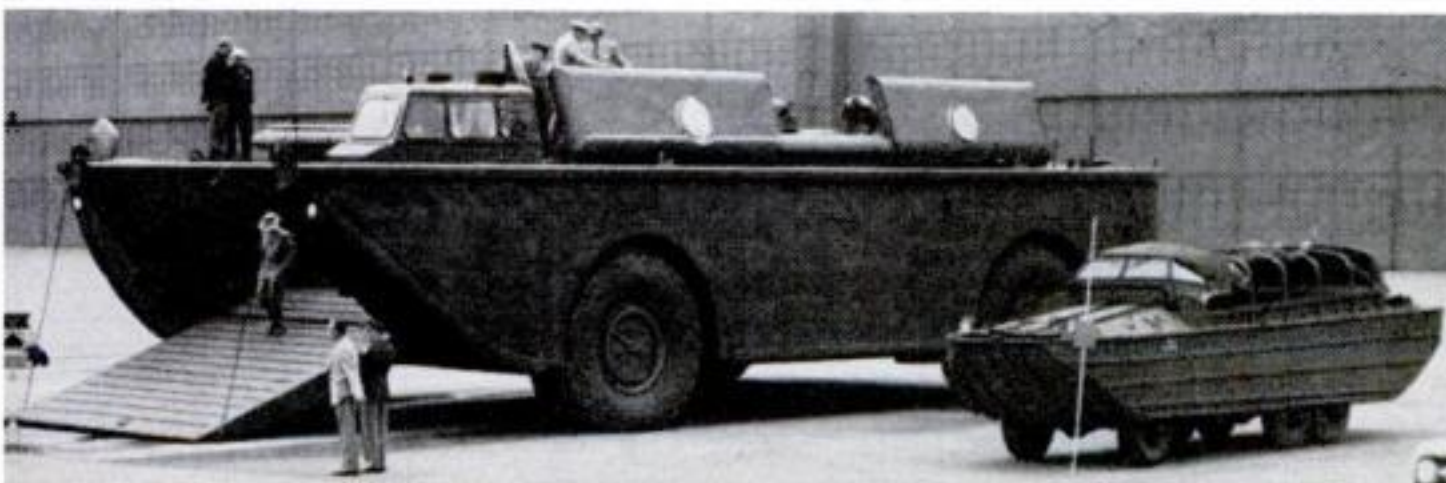
of its twin screws in water. Despite the BARC's enormous size, it will do 20 m.p.h. on land, 10 knots in water; go forward or backward; steer like a truck; or "crab" to either side with all wheels turned at a slant. In water, it maneuvers as easily as a much smaller landing craft.

There are 18 of the vehicles already in service. The latest models, six of which are now being built, cost \$300,000 each. The Army has been giving them extensive tests on both the east and west coasts of the U.S. and in France, Greenland, Okinawa, and Taiwan.



ENOUGH RUBBER for 150 automobiles is used in each of the BARC's giant tires. It's 9½ feet high, 4 feet wide, and weighs 2½ tons.

DWARFING THE DUKW, one of the earliest BARCs is shown at left beside 2½-ton amphibian that saw service in World War II.



It can't be true that a Frenchman loves his car first and wife next. How could this be the tin he loves to touch?

Doggedly down by the nose, this perky little French crate tackles any terrain with the enthusiasm of a lively pup.



France's Fabulous Flivver

How the oddball Citroen 2 CV, the world's ugliest car, has won a spot for itself as remarkable as that of our own Model T

No, no, the front end has not been embroiled in a crash. The wheels, they look like this when she is new.



*Les looks: terrible.
Le ride: magnifique!
L'economie: superbe.
1,200,000 owners can't all be wrong.
This car must have something, even if it doesn't show.*



Speed? Modest. Guts? Plenty. Sass? Of course, M'sieu. Enough to face terrifying French traffic.

By Harry Walton

Of such a ruggedness is the 2 CV that one might take it along when joining the Foreign Legion.



Can it climb? The Deux Chevaux holds the world's altitude record for motor cars—17,782 feet up in the Andes.

THEY'RE rare birds in the U.S. but sooner or later, if you keep your eyes open, you'll spot a slab-sided, slope-nosed little four-door car with a sun roof that rolls back like a window shade. If the wheels are turned, you may think it's been in a front-end crash. But after you've seen a few of this splay-wheeled breed, it will dawn on you that they're *built* this way.

Don't laugh. This is the beloved Citroen 2 CV, the Model T of France. Over *there*, they're all over the place. And they're not only loved; they're enormously respected.

Ask the man who owns one, and his eyes light up with enthusiasm. For this 1,125-pound ugly duckling is every ounce an automobile, with some audacious Gallic engineering under its homely exterior.

Even after you're told this, it's hard to take the 2 CV seriously. It looks as if it was designed by engineers who chloroformed the sales and styling departments, turned production over to back-yard shops, and had the body snipped out by demented tinsmiths.

When lightly loaded, it scurries along nose down like an automotive bloodhound, tail high over rear wheels placed way out at the corners. Starting off, the engine (typically in need of tuning) emits a series of slow bangs, and the car oozes away with more racket than getaway (sometimes because the French driver is starting up in third, which is possible in the 2 CV but hardly the way to show its heels).

About 1,200,000 of these cars are scooting around the face of the earth today. In its home land, the 2 CV has lately become a favorite of the well-to-do, the fashionable, and the intellectuals, who've decided it's smart to drive this low-priced, decidedly unsmart little crate. On far more solid grounds than snobbery, it has earned itself a remarkable reputation not only in France but in some of the more rugged corners of the world.

Several close looks begin to show why. Here's the story:

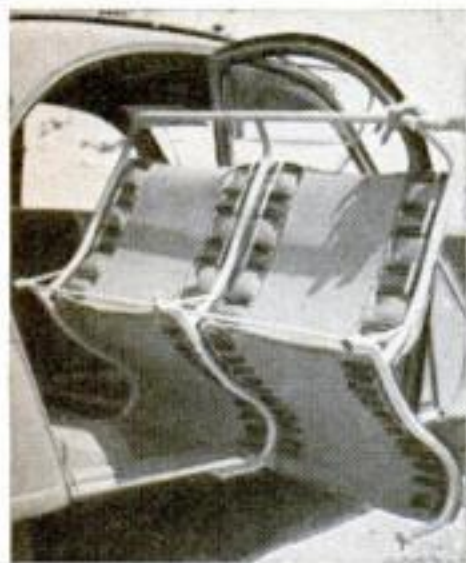
A million Frenchmen can't be wrong. On becoming eligible for paid vacations (by law) for the first time in 1936, they wanted cars to travel in. Engineers pulled out their drawing boards and went to work. Among the planners was the venerable Andre Citroen Corporation of Paris, builder of Europe's first mass-produced automobile back in 1919.

Designing a car for this new mass market was a job to turn Detroit heads gray. At Continental gas prices, it had to run on a mere whiff of fuel—but be roomy enough to carry a family. It had to be cheap—yet rugged enough for back-country roads, fast enough to make long trips, agile enough to climb mountainous roads. It also had to be dependable and easy to service. Looks were not even a secondary consideration (far more important: how much to replace a bunged-up fender?).

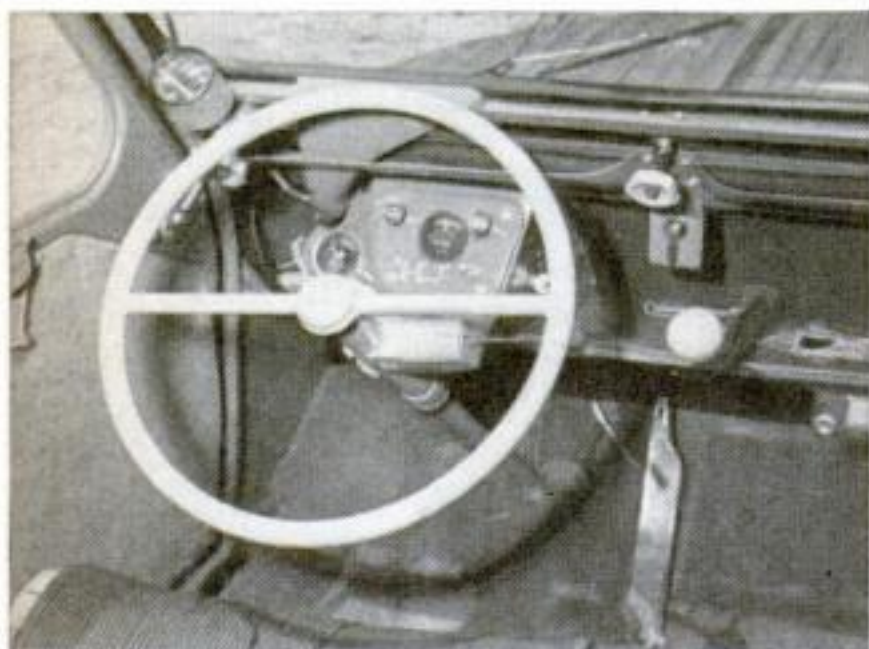
But the war brought all plans to a halt. It wasn't until 1947 that Citroen could dust off its blueprints and build, by hand, the first 2 CV—short for Deux Chevaux (two horses). Doors and other parts were weld-fabricated. The prototype was concealed until the 1948 Paris auto show. Then, before the President of France, it was unveiled.

Quelle horreur! The President was astonished at the car's downright ugliness. Citroen stockholders howled in

Stark simplicity and utility keynote the 2 CV's body . . . A



Fabric seats hang on rubber slings. Entire rear seat lifts out to make room for big loads.



Dash is crammed with standard but unrecognizable controls. Tucked into a windshield corner is speedometer.



Swung up, bottom half of front windows is held by a friction stud in a rubber socket.

anguish. Writers used blackest print to sneer. With other auto makers turning out sleek beauties even in low-priced lines, this freakish box on wheels seemed an affront to the French eye.

But in the austere postwar world, even basic transportation looked good to some. A few courageous souls bought the new cars. Gas-pump gossip got around that the 2 CV was as capable as a mountain goat, its ride amazingly comfortable, fuel economy good, upkeep and repairs easy on the pocketbook.

Even the ugly lines began to make sense. The body has good impact resistance. Damaged panels are so easy to replace that insurance companies made special rates for the car. It's a standing gag in France that you can buy a new fender at any hardware store, plus a screwdriver to put it on with, and get change from the franc equivalent of five bucks.

Demand for the car zoomed. By 1949 you had to wait four years for delivery. By 1950 it was six years. Factories began grinding out Deux Chevaux in England, Belgium, Indochina, Spain, and South America. By 1960 the wait was dropped to six months.

Like the Model T Ford, which you could buy in any color provided you chose black, the 2 CV comes in one standard color—battleship gray. It also resembles the Model T by seeming to run forever. Many an intrepid Frenchman drives a 2 CV with lights awry, wheels wobbling, and various bits of automotive plumbing dragging underneath. Ten-year-old models still fetch

\$300. A one- or two-year old 2 CV sells for only \$200 less than its cost, new, of \$950. There is only one body type—the four-door with canvas sun roof—and no yearly models.

Few emigrate here. To find one, I went far out on Long Island. A pretty young matron, Mrs. Charles Humbert, wife of a French businessman in New York, offered PS photographer Bob Borst and me a trial ride in the family 2 CV.

There's no conventional upholstery. Seats resemble right-angled hammocks. Yet they enfold you in rubber-suspended comfort. From the back, six-footer Borst said in mild amazement, "Hey, there's plenty of leg room back here."

The two-banger engine started right up (users claim it never fails even in winter, and two-car families usually say their 2 CV is more reliable than their larger car). Our hostess got speed up to 40 on a narrow paved road. "Now watch," she said casually, and hopped off onto an ill-kept, hole-pocked shoulder.

We braced ourselves for shocks. But the 2 CV seemed to soak them up like a sponge. You felt something being punished under the car, but the bumps hardly reached you.

"Let's go down to the beach," said the lady. With a flip of

two-lung engine drives front wheels that lean into turns

the wrist, she turned the car off into deep sand. It shuddered, dug in determinedly, and plowed through. Repeatedly the front-wheel drive clawed out of soft ground, including mudholes. A fairly steep grade with sand eight inches deep demanded only a downshift to second. In snow, drivers report, it's equally agile.

It's uncommon to get stuck in a 2 CV, for a hefty heave by two persons will lift one wheel off the ground. A couple of riders can muscle the car into a tight parking space, and tourists tell of seeing two men hold one corner up while a third changes a tire.

What's underneath? The amazingly soft suspension has each wheel mounted on an independent swing arm, the forward arms being pivoted on friction-disk dampers. Front and rear arms on each side are interconnected by tension rods to a common spring housing between them. Front wheels have shocks.

The four-cycle engine is a flat opposed twin of about 26-cu.-in. displacement. Compression is a modest 6.2:1, brake horsepower 12 at 3,500 r.p.m. The power plant has overhead valves, air cooling, an oil radiator, and a six-bladed, grille-enclosed fan. It doesn't overheat, even on long pulls.

Right behind the engine is the differential case. Power feeds through this to the transmission back of it. All four forward speeds are synchronized (Citroen calls the fourth overdrive, a subtle hint to shift down for any grade).

The clutch is part conventional, part centrifugal. In traffic, you can leave the car in second, and go or stop by shifting one foot from gas to brake. You cannot stall the engine, as the centrifugal shoes disengage below a certain engine speed. (They also make it impossible to start the car by towing or by rolling downhill.)

From the differential case just behind the engine, swing axles transmit power to the front wheels. As in other Citroens, the front-wheel brakes are inboard, at the transmission end of the axles. This lightens unsprung weight, permits bigger drums, and shifts braking stress directly to the chassis.

Low-fat diet. The few greasing points could be owner-serviced without putting the car on a lift. The engine takes $4\frac{1}{4}$ pints of oil, the transmission a quart. Two men who toured the world in a 2 CV tell of losing all their engine oil in the Chilean desert. They drove 300 kilometers to the nearest town by stuffing the crankcase with mashed bananas.



Rear wheels are way back, giving the car a 94½-inch wheelbase and a 26-foot turning circle.



Dual ignition coil (over fan) fires one cylinder from each end. Engine has a low-voltage timer but no distributor.

[\[Continued on page 165\]](#)

"I'd like to see them make..."



AN AUTOMATIC HAMMER operated by electricity and light enough for a workman to hold while

nailing up siding and paneling or laying down roofing.—*Morris Roth, Duncan, Okla.*



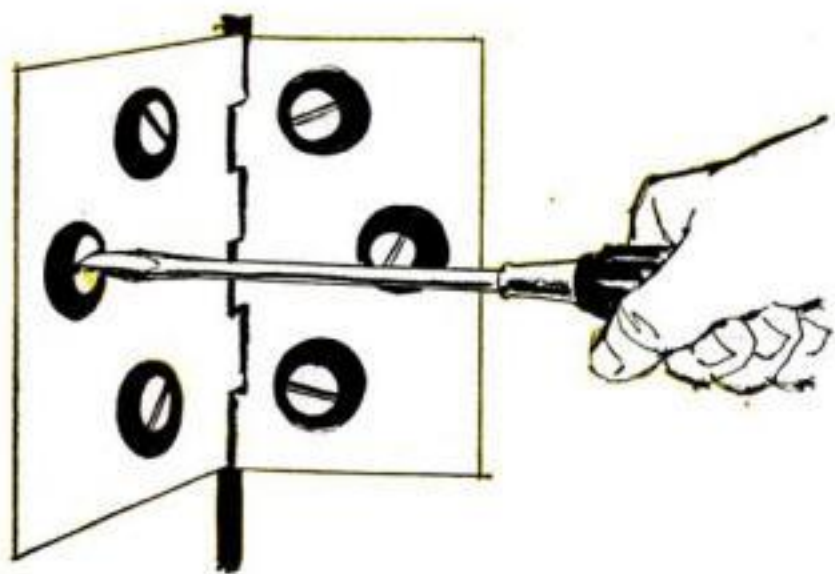
VENETIAN BLINDS silvered on one side to reflect the sun's heat in summer and painted a dull black on the other side to absorb heat in the winter.—*L. S. Nickel, Carlisle, Pa.*



KEYED ELECTRIC CIRCUITS marked clearly for every outlet area in the house. Then even a housewife could tell which fuse needed replacement.—*Ann Dickinson, Warner Robins, Ga.*



DRAIN-OFF PLUGS on chest-type food freezers. Then you could defrost the appliance without bailing out water by hand while standing on your head.—*Margaret Hageman, Stryker, Ohio.*

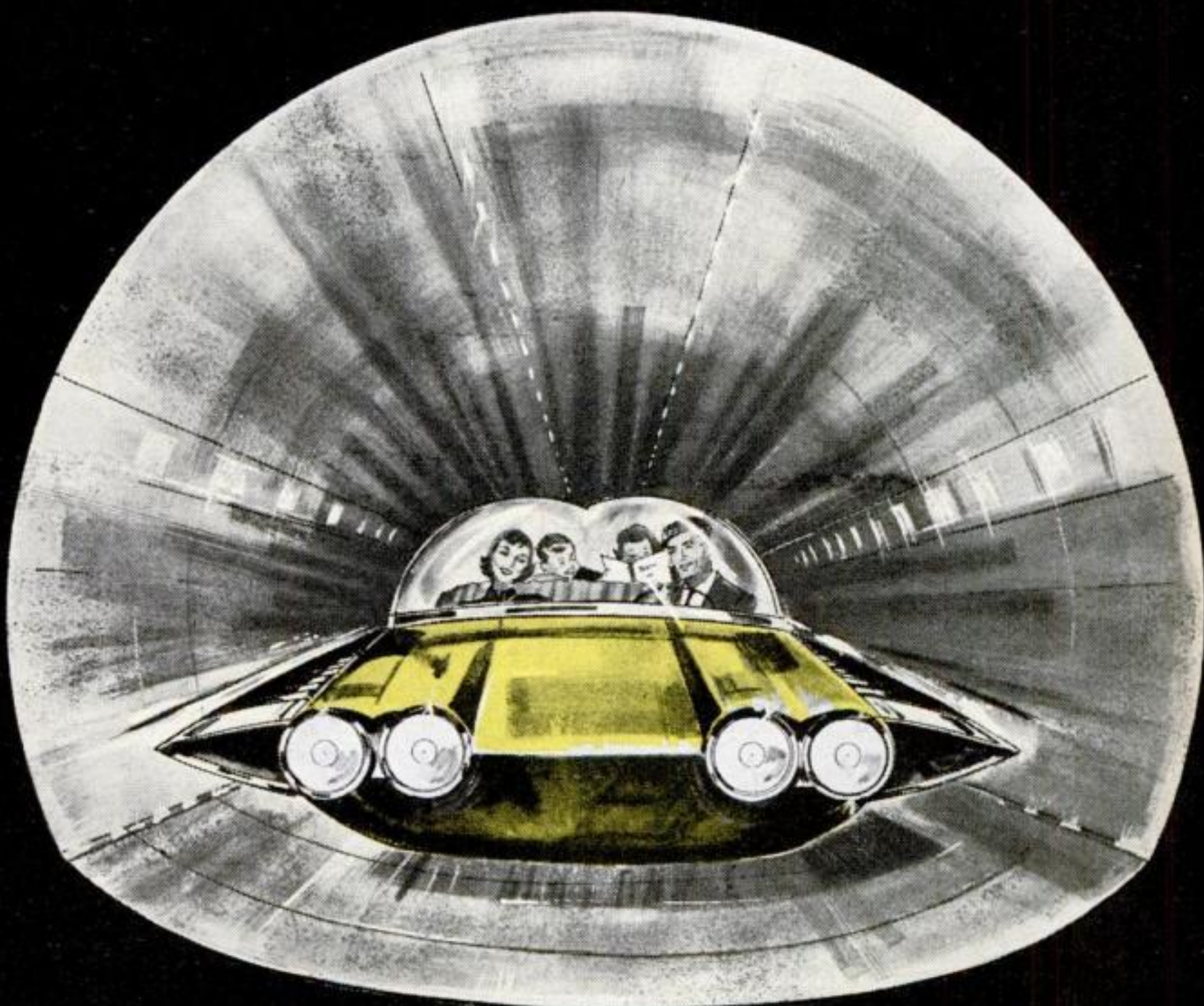


ADJUSTABLE HINGES to take washers with countersunk holes drilled offcenter for a screw. You'd turn the washers to adjust the door up, down, or to the side.—*D. Bousha, Jackson, Mich.*

Everyone has his own pet idea of a gadget that he would like to see in general use. What's *yours*? We will pay \$5 for each one published. Please use Government postcards

only. Send to ILTS Editor, Popular Science, 355 Lexington Ave., NYC 17. Write your name and address clearly. Contributions cannot be acknowledged or returned.

The fantastic future of travel:
1,500-m.p.h.
Family Cars?



Swept through Aeroduct pipe by a current of air, wheel-less cars could speed between cities.

The amazing future opened up by cars-without-wheels—the weird vehicles that glide inches off the ground on a film of compressed air—has excited the world. No one sees this revolutionary age more vividly than soft-spoken, determined Dr. William R. Bertelsen. A talented engineer as well as a Neponset, Ill., physician, Bertelsen has built some of the first and best of these remarkable machines. His newest model was bought by the U.S. Government for demonstration abroad.

On the following pages, he outlines for POPULAR SCIENCE readers a startling forecast for tomorrow's travel: family cars



that convert 3,000-mile trips into two-hour jaunts, that drive themselves automatically, that eliminate the parking problem. Unbelievable? You won't think so after reading his predictions.

CONTINUED

You'll cross the U.S. in two hours in an air car that steers and parks itself, predicts this pioneer designer

By William R. Bertelsen

FORGET that the wheel was ever invented, and imagine an ideal transportation system. Some possibilities will seem fantastic.

You want a machine that goes as fast as an airplane, but can't crash—and needs neither airports, roads, rails, nor harbors.

This futuristic car is already here: the GEM—ground-effect machine—such as the Aeromobile, which slides anywhere on a cushion of air. About 50 GEMs have already been built [PS, July '59].

The Aeromobile is the simplest powered vehicle: a motorized fan in a box with control flaps remotely controlled from the driver's seat. This is the entire mechanical system. There are no wheels, tires, axles, transmissions, differentials.

The GEM provides the smoothest possible ride. It is the most reliable vehicle because of its few moving parts and extreme simplicity. For the same reason it is the most economical to purchase, maintain, and operate.

The GEM operates over almost any surface. The ancient waterways—the Ganges, Amazon, Nile, Yellow River—become arteries of rapid, heavy traffic. Only a path is needed through jungle. Deserts and frozen wastes are thoroughfares.

But the most significant promise of the air-cushion machine is a completely



NO-HANDS DRIVING is easy with wheel-less car—roadway groove holds it on course. Electronic controls would be needed only at junctions.



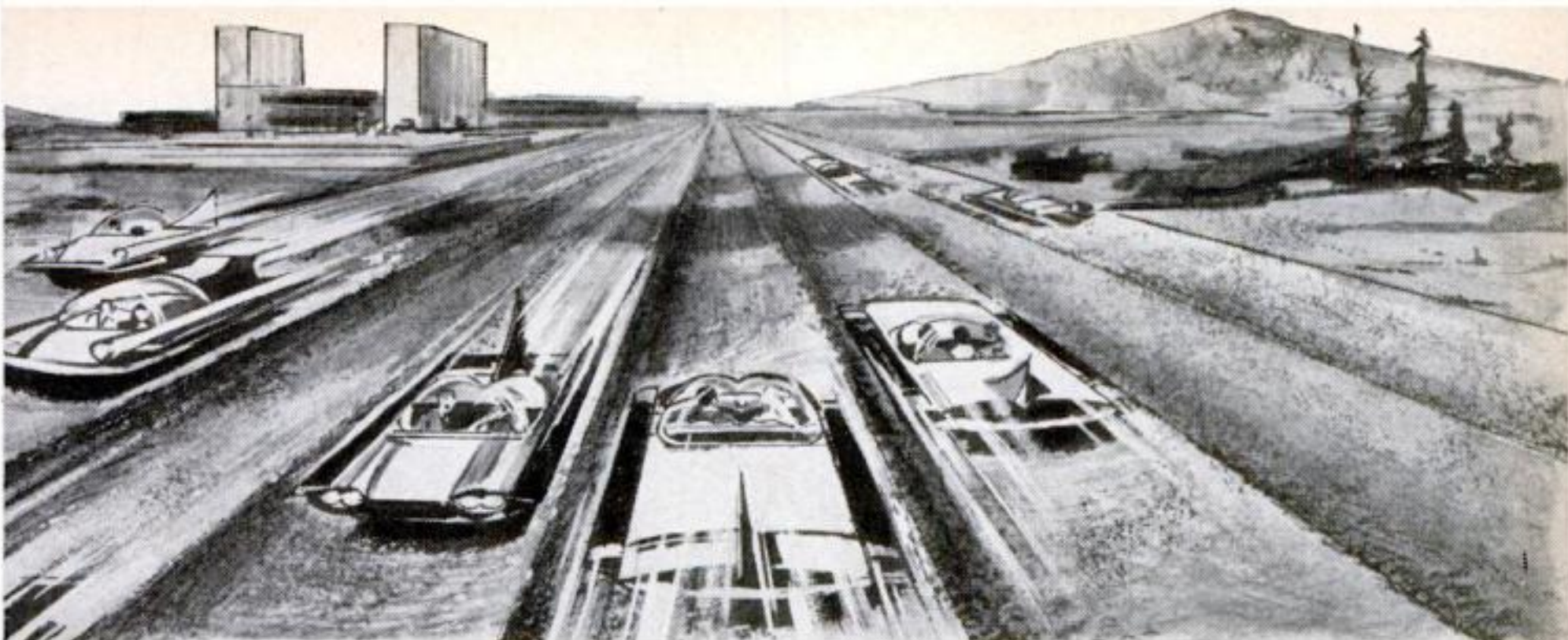
Suburbs could be linked by cheap "airways"

new traffic system, one in which safety, speeds, and total traffic can rise perhaps tenfold. Every mechanical and electronic principle involved is already in use today and available for the devices that I propose.

To begin with the simplest improvement, the Aeromobile can free people from bondage to conventional roads. The Aeromobile needs no gravel, no blacktop, no concrete. Suburbs could preserve rural beauty with nothing but broad grassy expanses leading from one town to the next. A clear, fairly level stretch of grass makes the ideal Aeromobile highway. Such highways—literally parkways—would be so cheap that a network could spread over enormous areas. The edge-to-edge dimensions of suburbs would increase and living space would expand.

Safer in the groove. The grass-paved airway would be much better—faster, safer, and more efficient—if it were shaped into shallow grooves. The Aeromobile centers itself in the groove, our tests show, and moves steadily forward at high speed without steering.

An eight-lane airway would be about 80 feet wide, the right-of-way now needed for four lanes of auto traffic. The parallel grooves, each about 18 inches deep and 10 feet wide, would accommodate 8-foot-wide vehicles. A driver would move to successively faster lanes toward the center as his speed rose. The outer lane should handle speeds to 50 m.p.h., the second lane 75 m.p.h., the third 100



paved with grass instead of concrete. Grooved shape of lanes automatically guides air cars.

m.p.h., and the innermost lane 150 m.p.h.

Such an airway could handle a collective 750 m.p.h. (adding speeds of all eight lanes). In contrast, the more expensive four-lane auto road has a collective 280 m.p.h. (even assuming 70 m.p.h. in each lane).

But the GEM is an aircraft. It can go as fast as other aircraft, even through supersonic speeds. The revolutionary difference is that it flies just above the ground, gaining almost all the advantages of flight without the danger of flight.

Flying in a tube. At groove speeds above 150 m.p.h., wind and weather would cause trouble. It will be better to protect the groove by making it the bottom of a tube. A steel pipe laid on the surface, a concrete tube under ground or under water, an aluminum tube suspended across canyon or river—these would provide the safest and fastest road ever known.

As the volume of vehicles rises over the years it would become economical to pump air with the traffic to reduce power consumption and noise (sonic boom) of the individual car. Velocities of Mach 1 or Mach 2—twice the speed of sound—would then be possible.

A tube trip from New York to San Francisco at 1,500 m.p.h. would take two hours. There could be 3,000 vehicles spaced one mile apart across the U.S. They would arrive in New York or San Francisco at a rate of 1,500 per hour. With four passengers in each car, 12,000

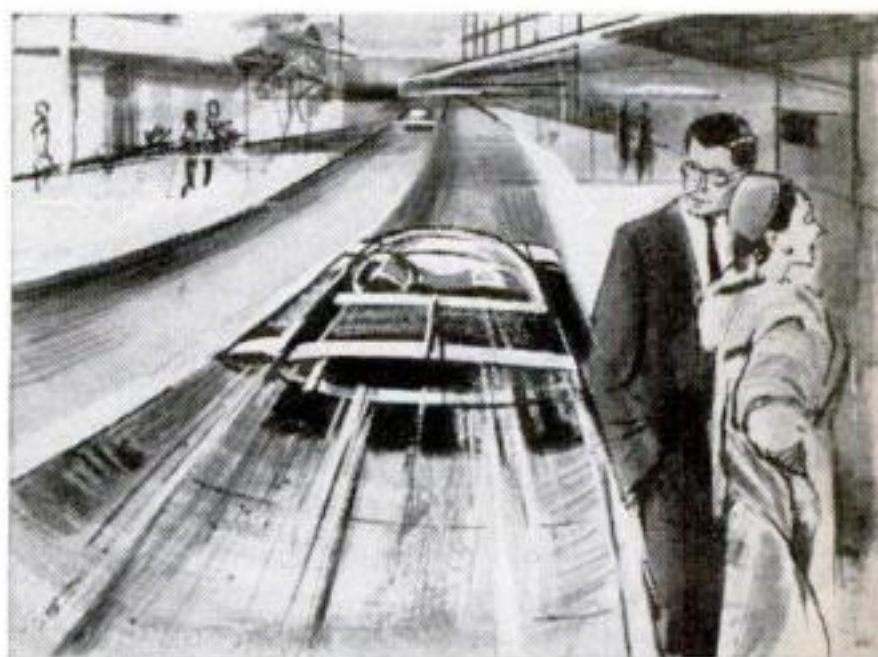
people could cross the continent every two hours.

An Aeroduct with forced air would allow the motorist to cut his engine down to fast idle—just enough to keep the machine airborne—and be swept along with the air current. This will save fuel.

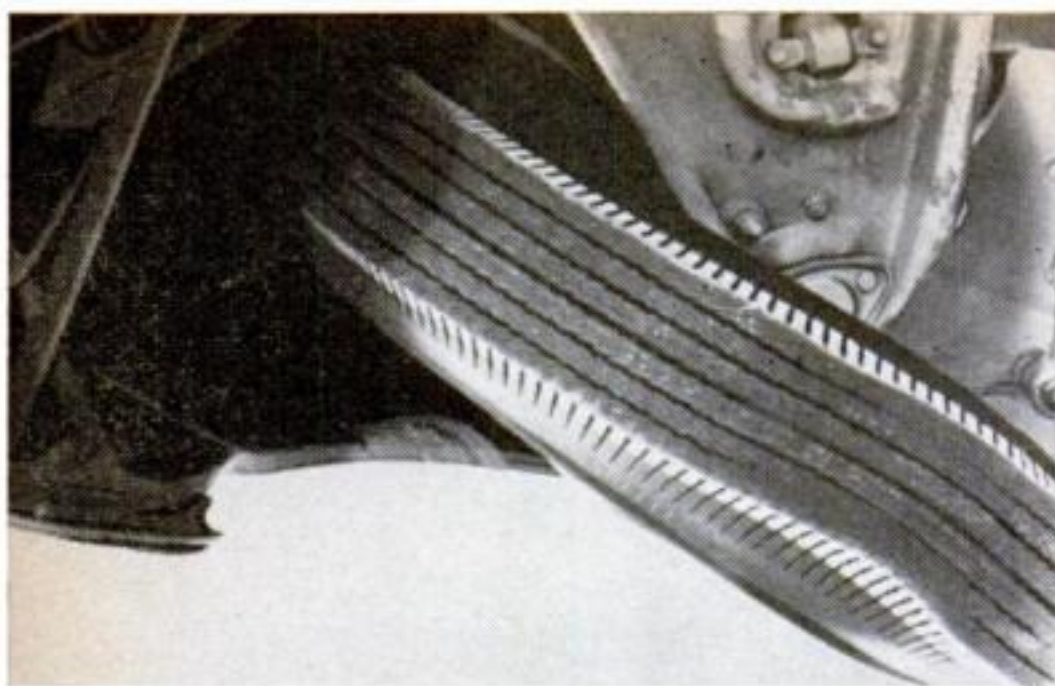
Cars in the Aeroduct would be pushed along in fixed positions and spacing from each other at whatever speed the air is blown, be it 100 or 1,000 m.p.h. There can be no danger of collision since *all* traffic would move with its medium, like boats in the Tunnel of Love. Cars could move from one Mach 2 air stream into another with no sensation to the passengers.

The air flow in this long tube would have to be boosted every so many miles

[Continued on page 178]



DON'T PARK IT; SEND IT HOME. With simple automatic controls, you'd send car back to your garage empty to wait until you called it.



◀ **TREAD DISTORTION** is on outer ribs as the tire shown at left made a turn.



CAMERA UNDER GLASS BRIDGE took shot. It's at left foreground of photo.



Road's-eye view of tire taking a curve

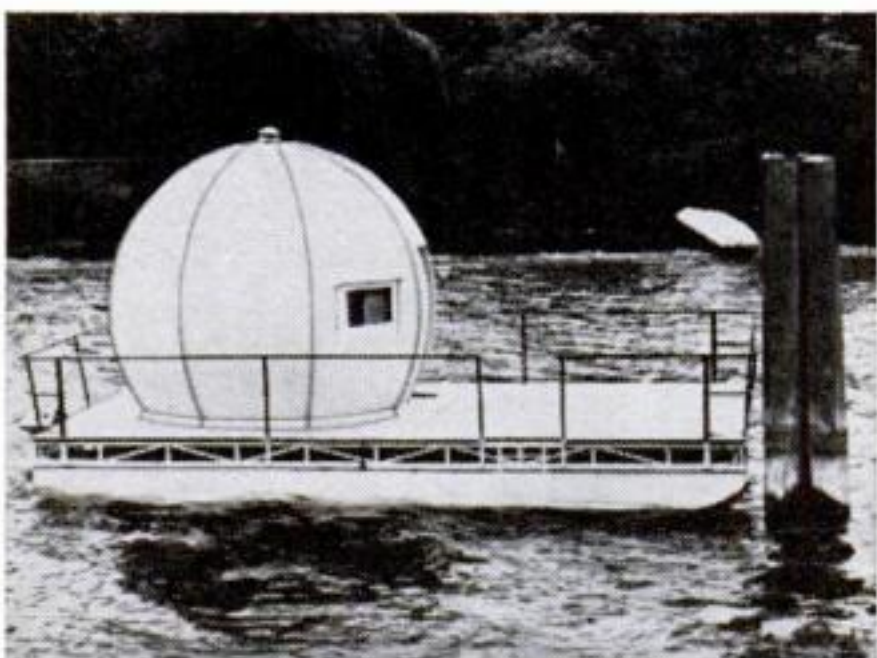
If highways had eyes, a tire making a sharp turn at 25 m.p.h. would look like the one in the photo at left above. The picture was shot from under a roadway constructed of sheet glass $\frac{3}{4}$ -inch thick.

Cameras and sound equipment were stationed in a culvert spanned by a glass bridge on a 126-foot track. The setup was for movie and still pictures used by B. F. Goodrich in television advertising.



Double-duty craters

A pattern of craters in an earthen embankment beside the Northwest Expressway in Chicago is the starting point of a practical as well as aesthetic treatment. Each hole will be filled with topsoil for planting a tree or shrub. The foliage will beautify the bank, the roots will anchor the soil and prevent erosion.



Pumpkin-cabin houseboat

Tourists along the Swiss and German banks of the Rhine may think it's jack-o'-lantern time when this houseboat glides by. The cabin is a plastic shell—with living room, kitchen, and bath. Assembled in segments, it was designed by a trailer builder as a summer house. The barge is propelled by an outboard motor.



Hedgehopping at 700 m.p.h.—faster than a .45-cal. bullet—or streaking across the sky at 60,000 feet, the B-58 is the—

World's Fastest Bomber

By Wesley S. Griswold

NEARLY everything about the paint-blistering B-58 is remarkable.

Just the rumors of it produced an extraordinary effect in the Strategic Air Command. Half the men in SAC's 43rd Bombardment Wing, at Carswell

Air Force Base, Fort Worth, gave up spot promotion elsewhere and as much as \$100 a month in pay to get the chance to fly in it.

If they had been content to poke along in their old jobs aboard B-47s and B-52s, higher rank and more cash would have come to them almost automatically. In-



IN TYPICAL TAKEOFF, nose-wheel high, a B-58 speeds at 240 m.p.h. Here the twin main eight-wheel bogie units are still on the runway.

CONTINUED



UNUSUAL COCKPIT VIEW shows single control stick in pilot's right hand. Says one B-58 enthusiast: "It is ideally designed. Everything

in the cockpit is within easy reach of either hand. You never have to raise up in your seat, even for refueling operations."

stead they fell for the glamorous new B-58, in whose squadrons advancement has had to be earned from scratch.

So dazzling is the performance of this 1,400-m.p.h. H-bomb carrier that its three-man crews seem delighted that they didn't let mere money and rank stand in the way of their fascination with it.

During recent war games, it successfully penetrated our own air defenses, creating red faces and gray hairs at Colorado Springs, headquarters of the North American Air Defense Command.

Listen to one of the 43rd Bomb Wing's top officers sound off about the B-58:

"I've been a pilot in two wars," says



HUSTLER LEGS are 10 feet tall to allow space during ground run for its underbelly pod, which is inserted from the rear. Inlet spikes of the four J-79 GE turbojet engines can move backward or forward as much as 15 inches. As the plane becomes supersonic, they automatically extend themselves to keep shock waves from entering the engine. Thus, the intake air is always subsonic.

Col. J. A. Hutchison, deputy commander for operations, "and if I had to be in another, I'd rather be in this plane than in any other I've ever flown. I'd feel a lot surer of getting home again."

The colonel gave a half-dozen compelling reasons for his jaunty confidence in the B-58:

- It can fly so fast, so high, and so far that no plane in anybody else's air force is likely to catch it. It has repeatedly traveled more than twice as fast as sound, races along easily at heights above 60,000 feet, and has covered 11,000 miles non-stop (with two mid-air refuelings).

- It carries such a clever bag of electronic tricks that it would be practically impossible for enemy radars and missiles to draw a bead on it.

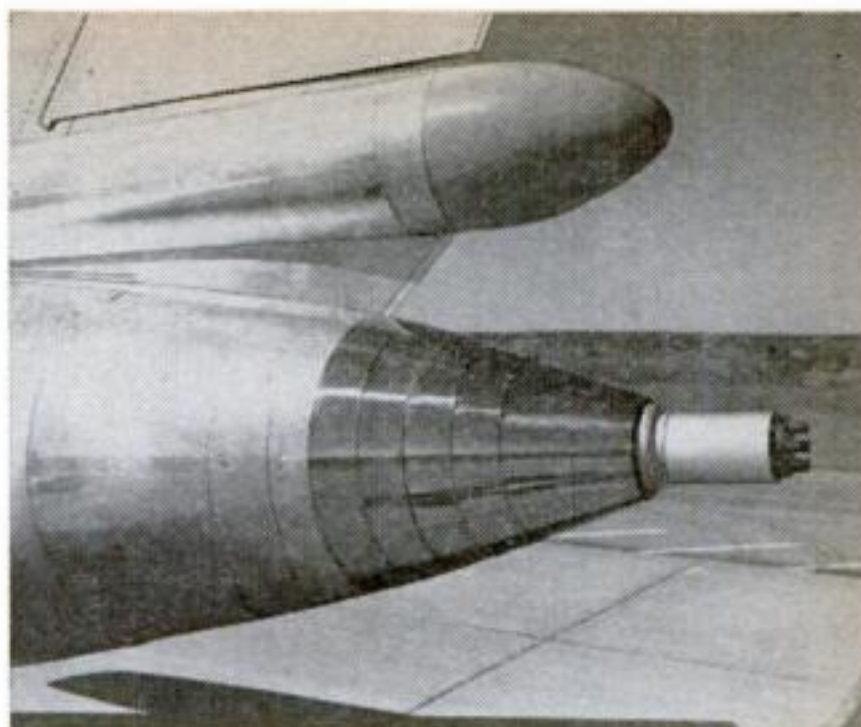
- It can hedgehop at 700 m.p.h.—slightly faster than a .45-cal. bullet travels—for hundreds of miles if necessary, to approach a target at an altitude where ground radars are blind.

- It is "solid as a rock" throughout its tremendous speed range.

- Its inertial-guidance navigation-and-bombing system is unbelievably accurate. (Military security wouldn't permit Col. Hutchison, or anybody else, to say just how accurate that is.) Last September, after only six weeks in service, a B-58 crew won SAC's radar-bombing competition against vastly more experienced B-47 and B-52 crews.

- It has a six-barrel, radar-controlled 20-mm. cannon on a flexible mount in its tail. The barrels rotate as in a Gatling gun, spewing 6,000 shells a minute at any intruder foolish enough to get in their way.

The B-58 looks deadly, as no other



20-MM. CANNON, the 58's only gun, is mounted at rear. It has six barrels that revolve like a Gatling gun, shooting 6,000 rounds a minute. Above is antenna of radar that aims it.

U.S. bomber does. That's because its delta wing and needle nose give it the appearance of a huge arrowhead. Its four slim, forward-jutting engine nacelles enhance that lethal look.

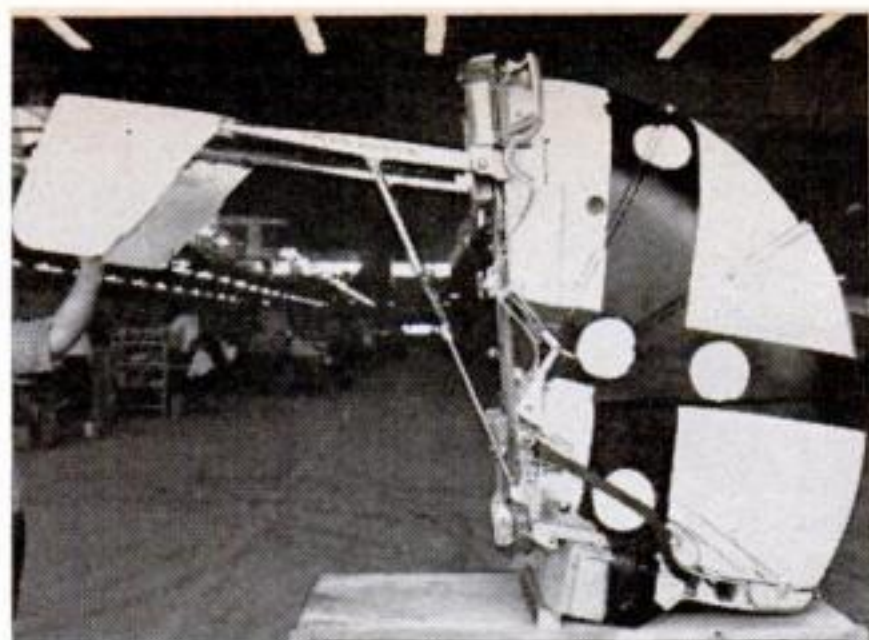
It weighs 80 tons at takeoff on an intercontinental bombing mission and carries more than 15,000 gallons of fuel, yet it is only one-third larger than a modern fighter, the F-102. The B-58 is 97 feet long and has a 57-foot wingspread.

It takes off with a routine load at 240 m.p.h. and climbs so fast that the pilot can't read the rate—it exceeds the indicator's limit of 6,000 feet a minute.

Pilots say that it handles more like a fighter than any bomber built, though it's much stabler than a "peashooter." Unlike any previous U. S. bomber, it can be flown with one hand—it has a modernized "joy stick" in place of a yoke.

TWO-COMPONENT POD (both fuel and bomb) has just been attached. Raised hoods show tandem positions of the three crew members, smallest number required in any U.S. long-range bomber. Space between the pilot and bombardier - navigator (who is second in row) is occupied by the remarkable computer that is the B-58's electronic brain. It measures only three cubic feet in size.





EJECTION SEAT is designed for supersonic speeds. Crewman at left grabs handle that would start process of enclosing him in a pressurized escape capsule and firing rockets to hurl him into space. Above is shown the closed capsule in which he would be parachuted to safety.

Its J-79 engines, producing more than 15,000 pounds of thrust apiece with afterburners, push it so fast that they'd melt if the plane exceeded its red-line limit. Yet even at that limit, the engines have power to spare.

With its "coke-bottle" waist and pointed nose, it slips through the sound barrier without a quiver. "Drop the nose just a little," says Col. Hutchison, "and, whammo, you're supersonic in nothing flat. There's nothing but a click on your instruments to tell you you've done it."

A "manned missile." The B-58 is so nearly automatic that it has been called a pushbutton plane, a manned missile. Once airborne, the plane can be put under control of a marvelous electronic brain. It can actually fly, navigate, and bomb by itself. That doesn't mean that the crewmen, who sit in tandem, in separate compartments, just go along for the ride. They—pilot, bombardier-navigator, and defensive-system operator—spend most of their time watching instrument faces or radar scopes, alert for trouble and exhaustively trained to meet it.

The most curious aspect of the B-58, yet one of its most important assets, is its ability to carry bomb load and extra fuel in a disposable pod, fastened to its belly. The latest pod is 55 feet long and weighs 18 $\frac{1}{4}$ tons loaded. It is really two pods, one fitting inside the other. The bigger one contains only fuel; the smaller holds both fuel and bomb.

This slick arrangement does away with the need to lug home empty bomb racks

and drained fuel tanks. Once the B-58 has burned its extra fuel and dropped its bomb, it sheds their containers as well, and can streak back to its base with no dead weight. Its main fuel supply fills most of the wing and part of the fuselage.

On a typical mission, the B-58 flies at subsonic speeds most of the way to its goal, then darts in for the kill at Mach 2. At twice the speed of sound, it has to release its bomb three times as far away from the target as B-47s and B-52s do. At that speed, it takes 44 miles to turn around and sprint for home.

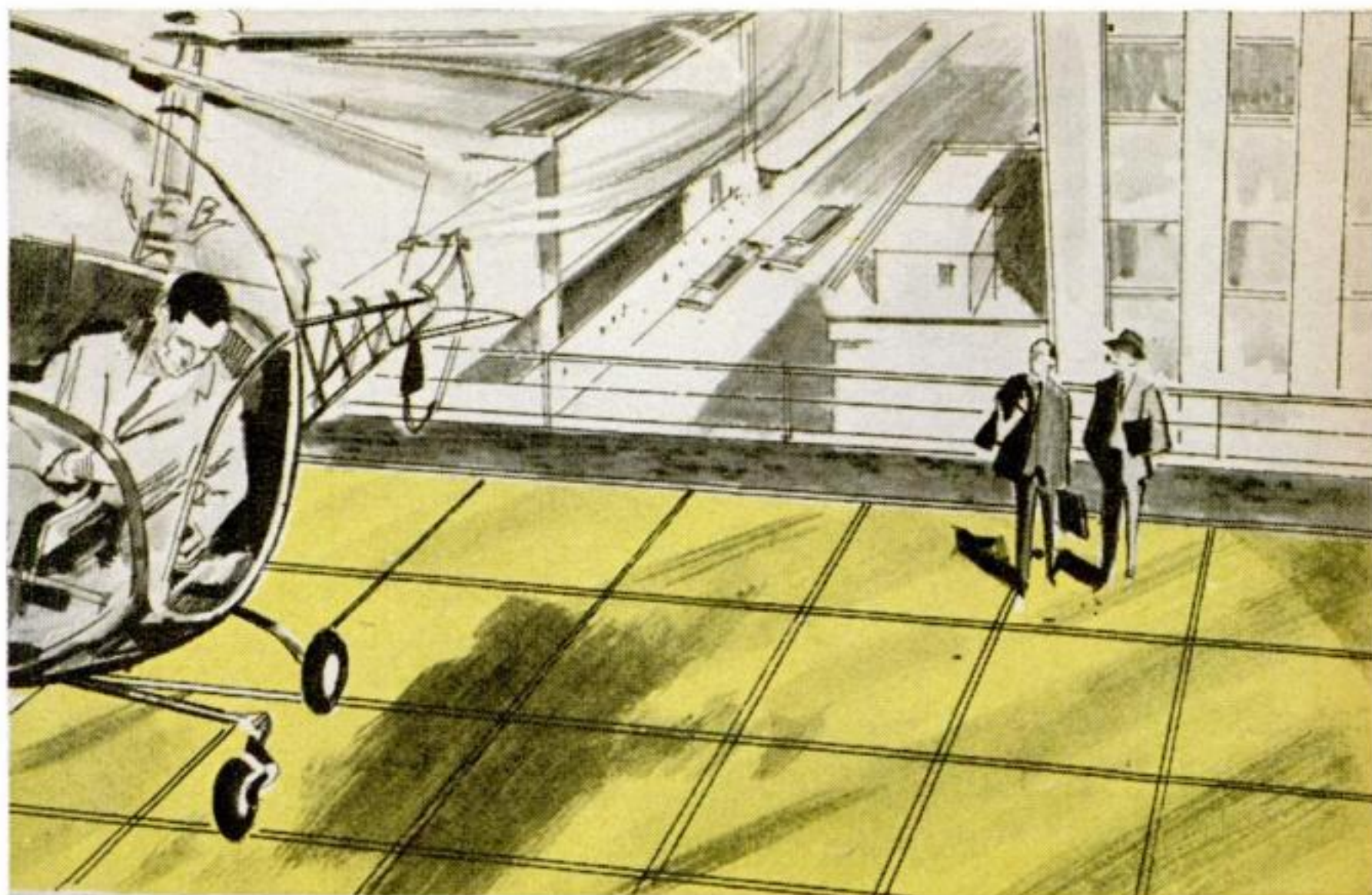
Skin temperature: 260 degrees. When it's going fastest, the friction of its blazing passage through the air raises its skin temperature as high as 260 degrees. Prolonged flight at that speed, which the B-58 is capable of, would cause structure-weakening "heat-soaking" if it were not for the plane's remarkable construction.

Most of its exterior consists of panels of metal-sandwich material—thin layers of aluminum or stainless steel bonded to fillers of honeycombed aluminum, fiberglass, or stainless steel. This type of construction did away with a ton of welds and rivets. It also gave the plane greater strength and a smoother surface than did any previous method, and cut heat absorption by at least 100 degrees.

In addition to being insulated by the plane's body, B-58 crewmen and their complex electronic equipment are kept cool by an air-conditioning system adequate to chill a half-dozen two-bedroom

[Continued on page 182]

New Ideas from the Inventors



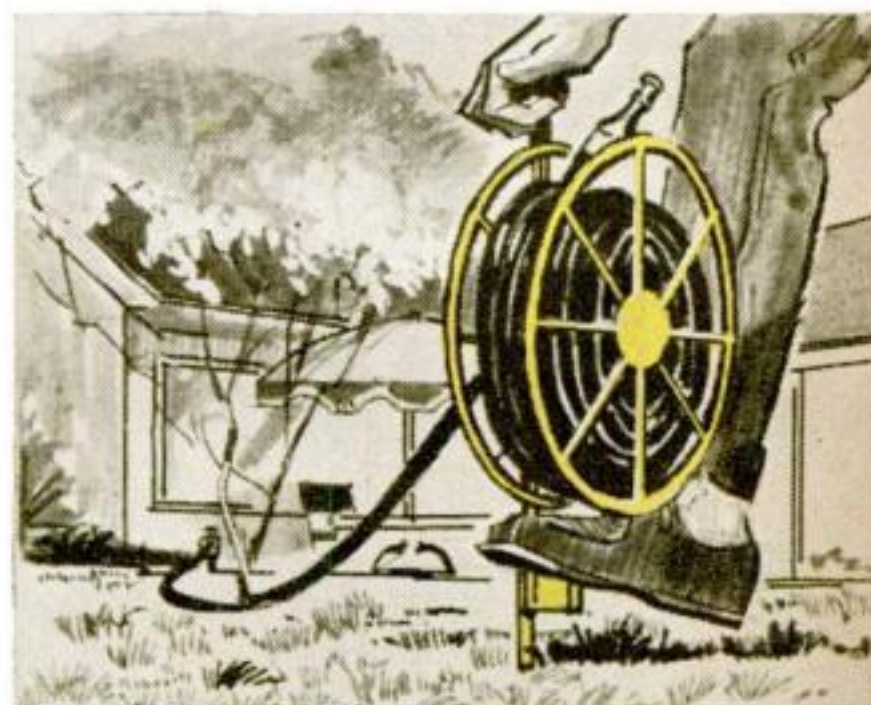
Roof Mats Spread Copter's Weight. Almost any large, flat roof could double as a heliport without costly reinforcement, according to this recent patent. To keep the craft's weight from being concen-

trated under its landing gear, the inventor proposes a tile-like arrangement of fluid-filled mats. They'd spread the load over a larger area for easier support by a conventional roof structure.

Headboard Props You Up. You wouldn't have to wrestle with a slipping pillow to read or breakfast in bed if your headboard were padded with these tilt-out cushions. Held flat on ledge supports, they'd pull forward and slide down on guide rods to form angled backrests.



Spiked Reel Anchors Hose. Mounted on a rod with a handle at the top, a garden-hose reel might be easier to carry and use. You'd drive the pointed end of the rod into the ground. A horizontal blade-like brace would keep it from turning as the hose were wound and unwound.



CONTINUED

75



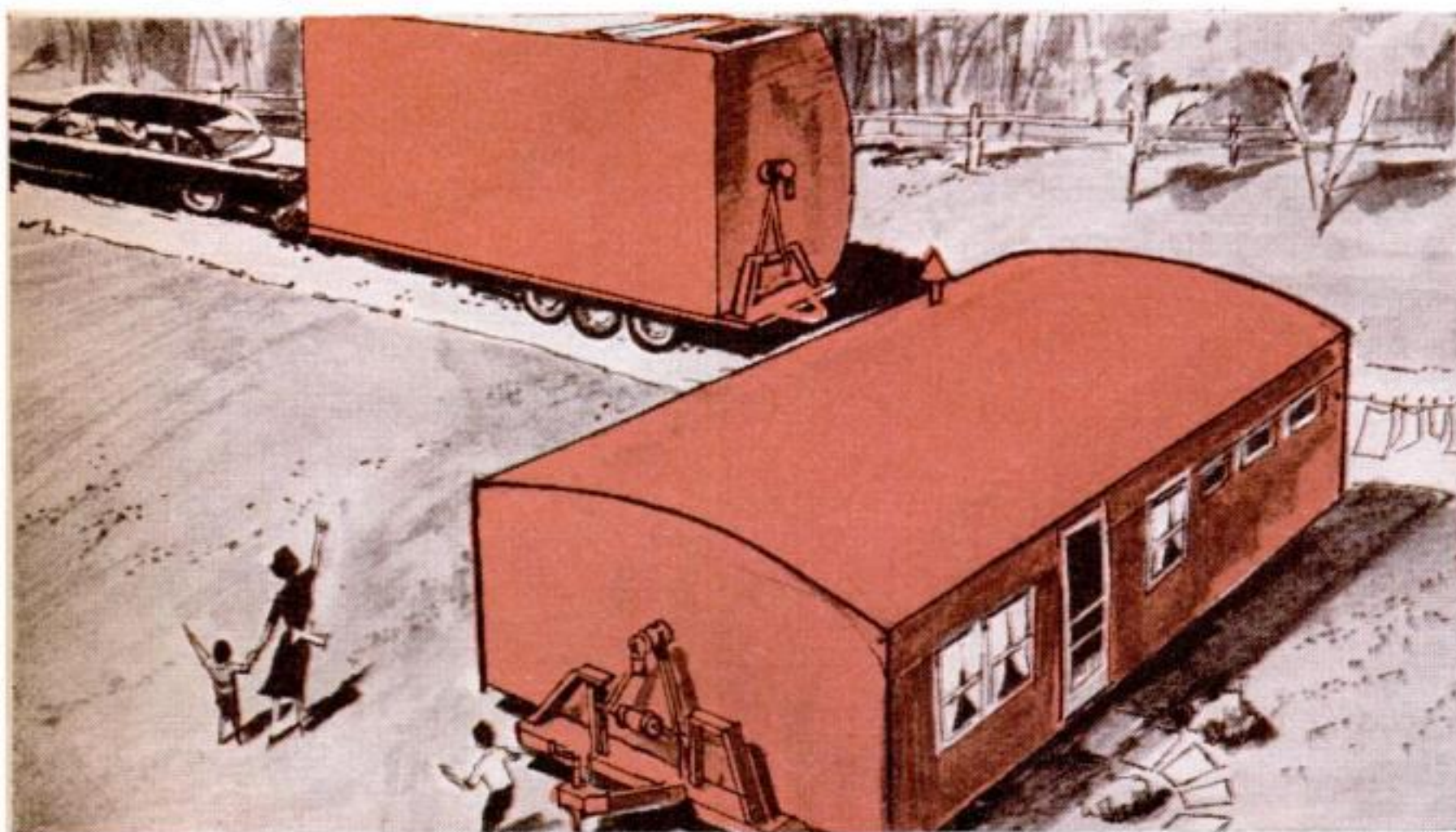
Beach Rack Conquers Sand. Hooks and pockets on this knock-down pole would keep your towels, soda, lotion, cigarettes, and other beach gear high, dry, and sand-free. The trays and hooks would slip on and off the sectioned pole for compact storage, easy carrying, quick assembly.



Convertible Ladder. You could tackle most jobs with one ladder if it came in sections put together with socket-jointed bars. Coupled one way, two sections would form a self-supporting step ladder; twist the bars around, you'd have an extension-type straight ladder.

House Trailer Rolls on Side. Although trailer homes keep getting longer and fancier, their furnishings and living space are restricted by the eight-foot width limit on highway vehicles. But a trailer

might be made wider and more comfortable if it were swivel-mounted, as shown, on a wheeled platform. It could trade height for width while traveling, regain its spaciousness when parked.





Mower Bar Guards Your Feet. You couldn't step too close to the blades of a power mower, even on a steep hill, if it had a guard rail like this clamped behind the blade housing. The bar would extend far enough to stop your ankle before your toes could reach the danger zone.

Iced Canopy Cools Lawn Chair. You could enjoy air-conditioned comfort outdoors under a refrigerated canopy like this. Fins and channels in the metal box on top would direct outside air in and downward. When the box was loaded with a chunk of dry ice, it would cool the air on its way to you. Similar coolers might be attached to parasols or tents.



Jack "Aims" Falling Tree. This hydraulic jack might take some of the hazard out of tree chopping. After making the usual felling cuts on opposite sides of the trunk, a woodsman would place the jack so its pronged plates would grip both ground and bark. He'd then crank it to give an accurately aimed push.

The following patents have been issued on these inventions: Roof mats—No. 2,920,846 to F. E. Lingafelter, Mansfield, Ohio; Headboard backrest—No. 2,844,829 to W. G. Levy, N. Conway, N. H.; Hose reel—No. 2,815,181 to G. A. Dickinson, Davenport, Iowa; Beach rack—No. 2,924,338 to B. C. Sharp, Pitman, N. J.; Ladder—No. 2,834,528 to K. W. Couse, Newark, N. J.; Trailer—No. 2,845,298 to O. R. Stoces, Chicago; Mower guard—No. 2,963,842 to J. L. Estes, East Point, Ga.; Cooler—No. 2,963,881 to V. Stark, NYC; Tree jack—No. 2,960,309 to G. Swanson, Hollis, N. H.

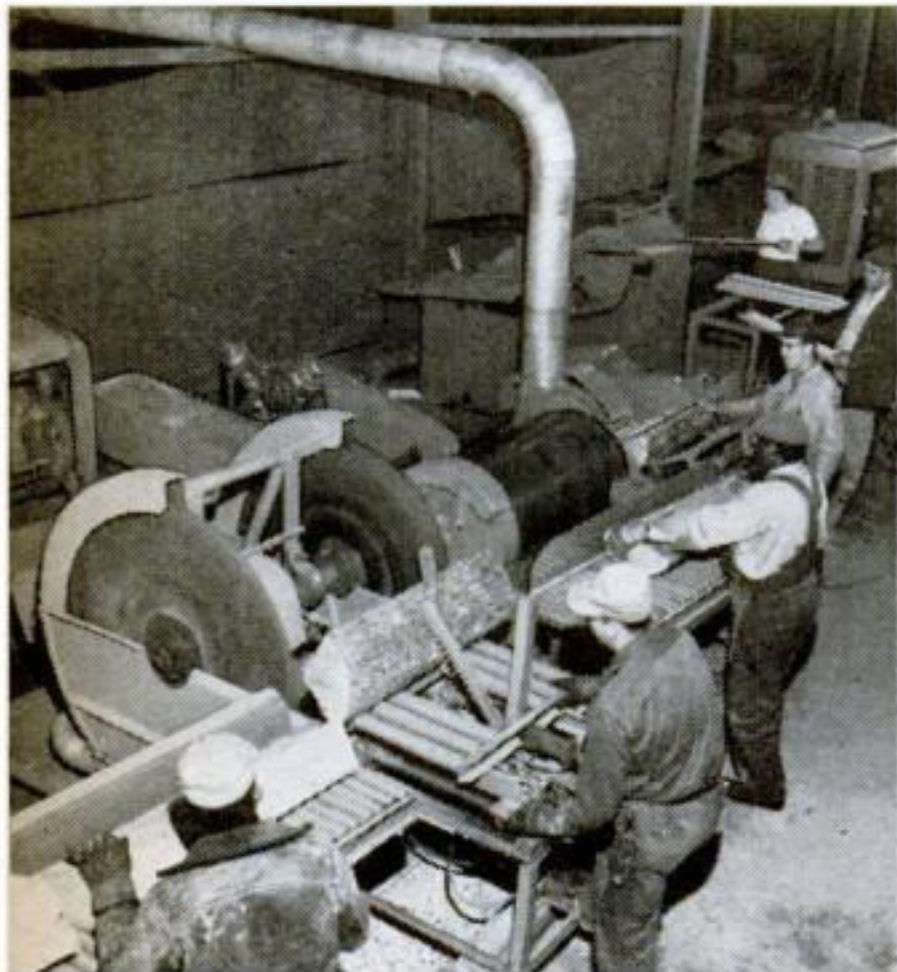
Copies of patents may be ordered, by number, from the Commissioner of Patents, Washington 25, D. C., at 25 cents each. To write to an inventor, if the address given above is insufficient, you may address him (by name and patent number) in care of the Commissioner of Patents.

How whiskey barrels are made

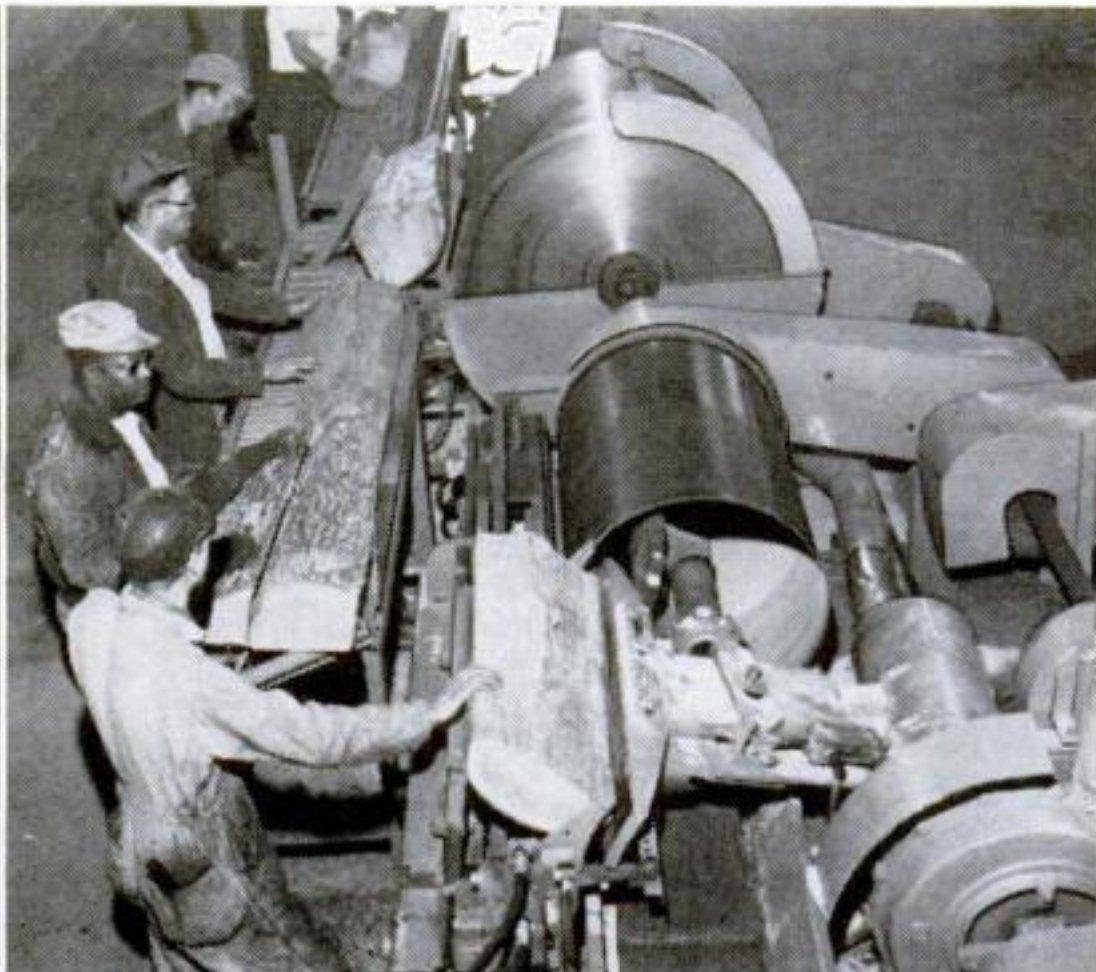
A half-million whiskey barrels a year are turned out at the National Distillers' cooperage plant at Memphis, Tenn., the world's largest. It takes more than 12 months to make each one, which is used in this country only once. Federal law requires new white-oak barrels for aging

bourbon and rye in bond. Chemical action of the charred new wood is believed to give whiskey its color, flavor, and taste. But some foreign distillers prefer used barrels, so many are shipped abroad after their use here.

How whiskey barrels are made is shown



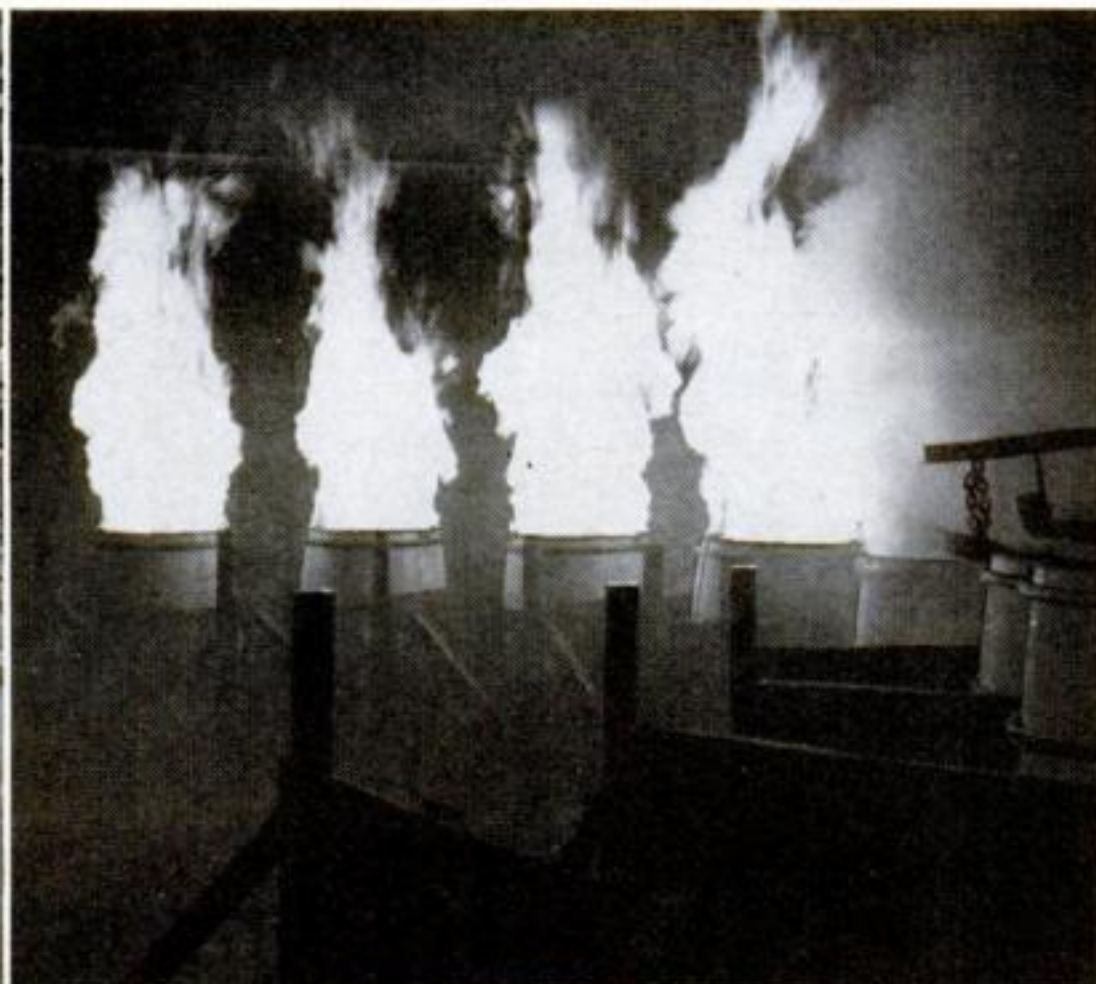
1 TWIN CIRCULAR SAWS, separated by the length of a stave, trim quartered logs of white oak to exact 50-gallon-barrel size.



2 DRUM SAW at end of line next cuts staves to required thickness. It is same diameter as barrel to give staves the proper contour.



4 TRUSS RING AT BOTTOM (rear) is filled with staves, which are pulled tight by rope, and held together at the top by a temporary hoop.

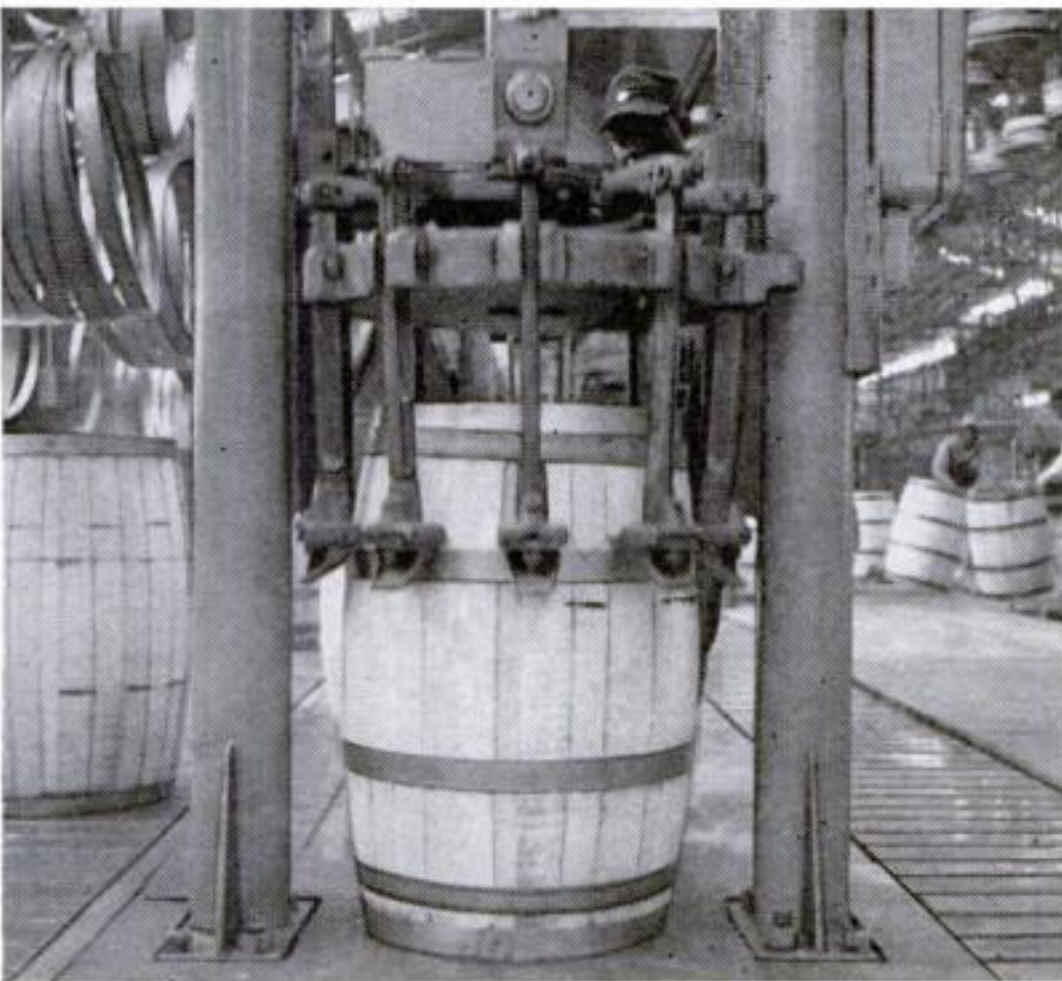


5 FIRING INSIDE is by gas flame on circular conveyor timed to quench barrel under sprinkler (right) when charred to proper depth.

in the photos below. Logs are sawed into staves in saw mills at the timber sites, and are then graded and stacked to dry in air for at least a year. From there they go to the Memphis cooperage, where they are inspected, kiln dried for another 10 days, and put through the barrel-making assembly line. The Memphis plant turns them out at the rate of up to 3,000 a day.



3 STACKED ON PALLETS with spacing to let air circulate, staves are lifted onto racks in drying yard where they remain for 12 months.



6 AUTOMATIC HAMMERS drive final hoops on after removal of trusses. Tops and bottoms fitted in, barrels are shipped to distillery.



Motorized postcards

Ever try to select a postcard from one of those revolving racks while somebody else was looking at another of its four sides? This rack works automatically on pulleys driven slowly by a motor. Back-to-back cards are clipped at the top to bars, flip right-side up on either side. To make a purchase, you unclip your selection while the rack is moving. The device was displayed at a fair in Milan, Italy.



Drive-in traffic court

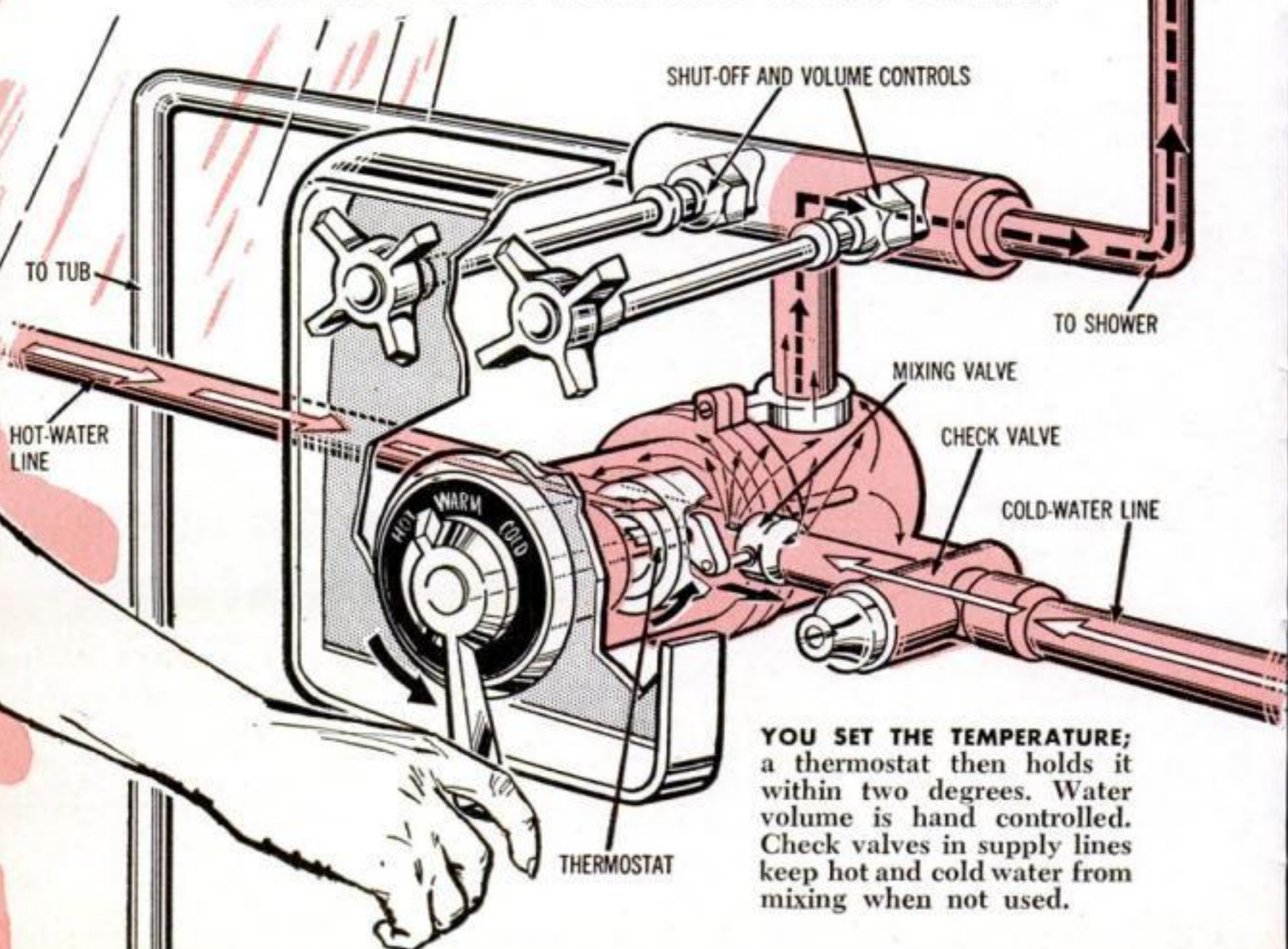
An understanding judge in Dearborn, Mich., now lets errant motorists pay fines at a toll booth without getting out of their cars. Here he is inspecting a closed-circuit TV that lets the judge and minor offenders see and talk to each other during hearings.



How an Automatic Shower Valve Works

TWO hand-controlled valves feeding into a tee will mix hot and cold water. But if someone waters the lawn or starts an automatic washer while you're showering, you feel the difference fast, perhaps uncomfortably.

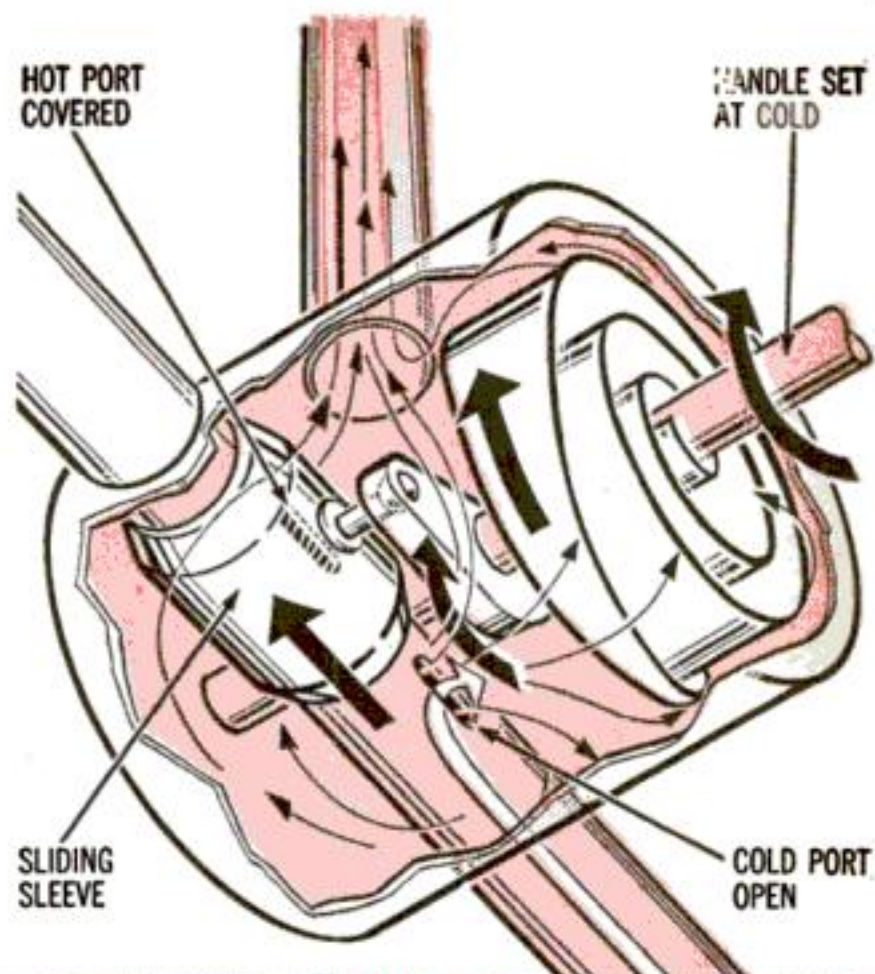
Not so with a thermostatic shower valve. Set to the desired temperature, it admits only water of that temperature (or as close as the supply permits) into the shower head. If the hot-water supply diminishes, it cuts down on the cold. If the cold water fails, it cuts off the hot. Shown here is the Showermaster, made by the Leonard Valve Company, of Cranston, R. I. Separate hand valves control volume either for bath or shower.



YOU SET THE TEMPERATURE; a thermostat then holds it within two degrees. Water volume is hand controlled. Check valves in supply lines keep hot and cold water from mixing when not used.

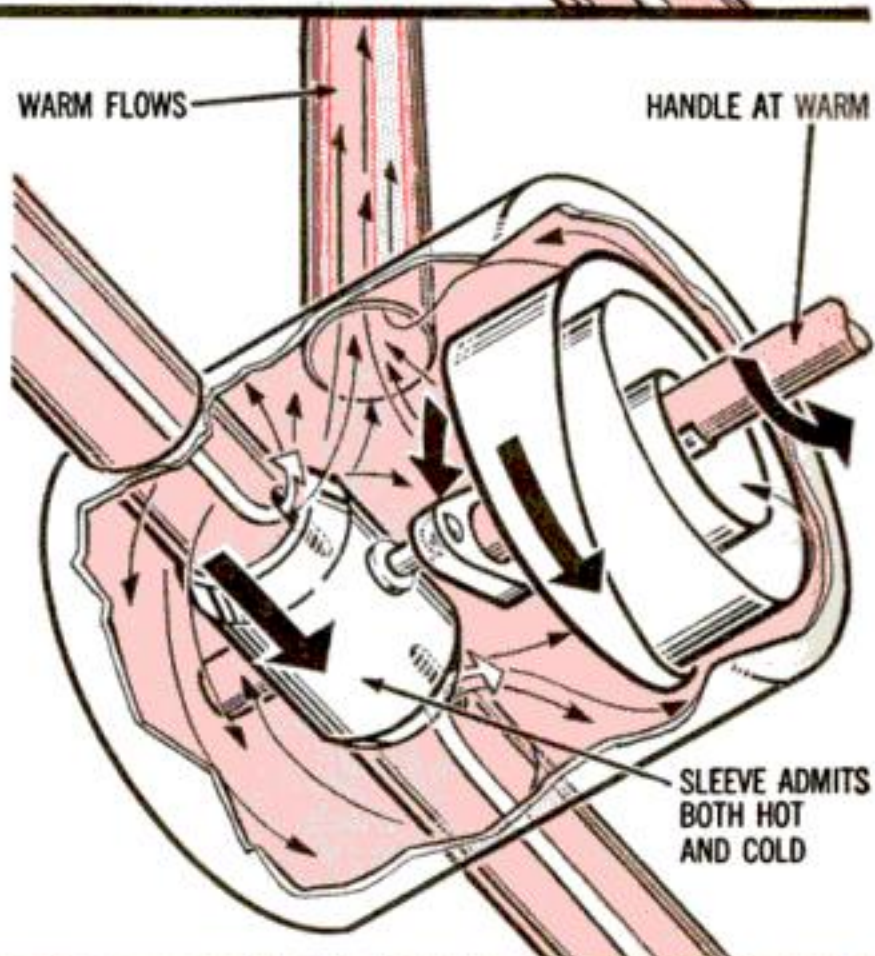
How you get a cool shower

TURNING THE SELECTOR to COLD rotates a shaft fixed to the inner turn of a spiral bimetal thermostat. The other end of the coil is fastened to a short crank arm with a hole at its outer end. In this hole is a ball-ended stud set in a small sleeve. The sleeve slides on a short cylinder connected at one end to the hot, at the other to the cold-water line, with a center divider inside and four elongated ports at each end. The sleeve determines how much hot or cold water passes through the ports. With the selector at cold, it is held over to cover the hot-water ports entirely, opening the cold ones wide. Thus only cold water flows into the shower for those hot-day refreshers.



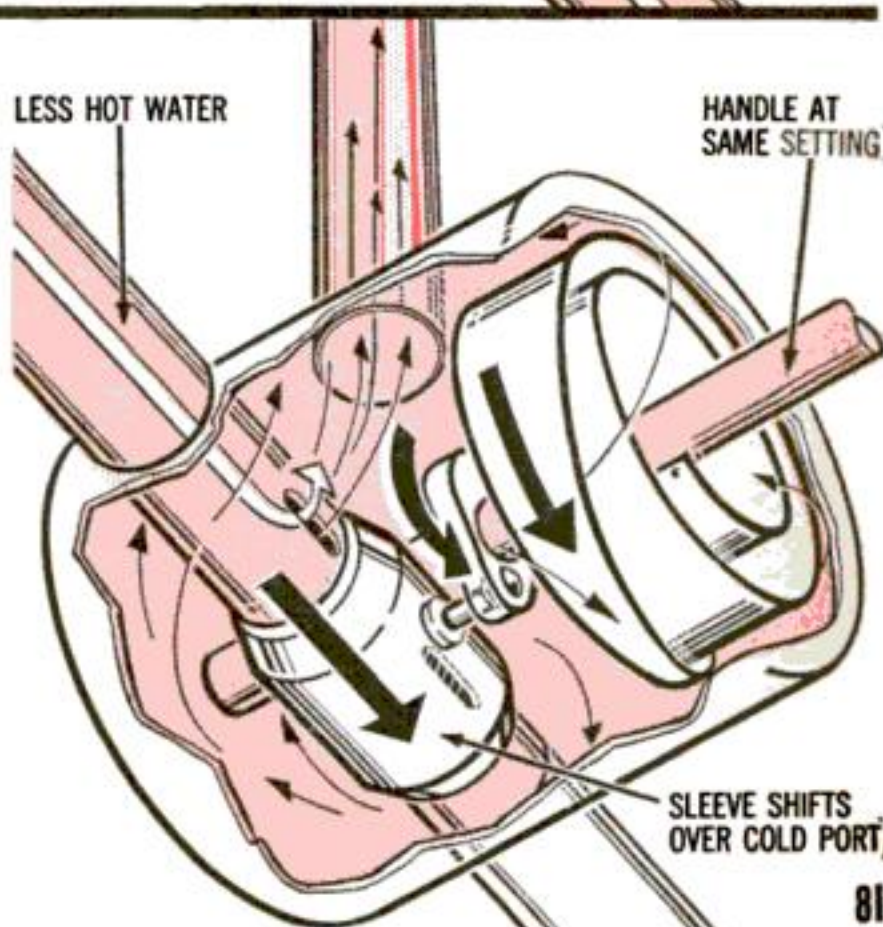
How water is heated to suit you

THERMOSTAT TAKES OVER when you move the selector to a warm setting. The bimetal coil follows and moves the sleeve right, closing the cold and opening the hot ports. The hot water expands the coil, moving the crank arm left. This partly closes the hot ports and partly opens the cold. But the resulting somewhat cooler mixture again opens the hot ports more. Thus the thermostat hunts that temperature at which the coil, its position determined by the selector setting, stabilizes and holds the sleeve steady. The action is almost instantaneous. If selector setting is altered, coil tension will again shift the sleeve until the new temperature re-stabilizes it, giving you what you want.



When hot water dwindles . . .

A SUDDEN DROP in the hot-water supply, such as occurs when it is turned on elsewhere, lowers shower temperature only two degrees before the thermostat reacts by moving the crank arm to right. This closes the cold-water ports farther or all the way, admitting proportionately more hot to maintain the temperature. The same thing happens if the temperature, but not the volume, of hot water falls off. The thermostat makes maximum use of what hot water there is. If its temperature falls below the selector setting, the valve delivers the warmest water available. Conversely, if the cold should suddenly fail, it saves you a scalding by quickly cutting off the hot-water flow.



Tiny Two-Wheelers Run All Week on a Gallon of Gas

By Howard G. McEntee

A BREED of two-wheeled vehicle far smaller than the conventional motorcycle is invading our roads in ever-increasing numbers.

It doesn't make very comfortable transportation. Usually it's little more than an engine, frame, and wheels. Often it lacks such niceties as suspension and fenders. Even its staunchest supporters admit it's underpowered; most models cruise at only about 30 m.p.h. and a few can't top 10.

But the diminutive rigs—motor scooters, light motorcycles, power bikes, call them what you will—have one big advantage: an economy that puts compact cars and even imported mini-cars to shame.

Most sell for under \$300. Some are around \$100. But your savings don't end there. Being much lighter than motor-



NEWLY INTRODUCED AUTOCYCLE by Midget Motors has a two-speed automatic transmission with passing gear. Its suspension consists of telescoping spring-and-shock tubes built into the front forks. The fender steel is 16-gauge.



TINY ENOUGH to be tucked away in a lightplane, small boat, or car trunk, 42-pound Alzina Playboy can be driven by a seven-year-old or a 200-pounder. The 1½-cu.-in. engine does 10 m.p.h. Gearing for 15 m.p.h. is available.

COMPARATIVELY CIVILIZED Sears Mo-Ped at left has magneto-powered dual-beam headlight, stop light, tail light, electric horn, speedometer, and luggage rack. Top speed is 31 m.p.h. Windshield and foot guards are optional.



CHOICE OF DRIVE RATIOS for flat or hilly country is available for the Luther Viper Cycle at left. Heavy-duty Trail Goat (right) weighs

over twice as much and is equipped with sturdy luggage carrier for heavy loads. Front and rear springing are extra-cost options.



IT FOLDS UP for easy transportation and storage. Snap open a C & E Argyle Scooter Cub (it takes 15 seconds) and you're ready to roll. Recoil starter and fully automatic clutch are featured. Top speed is respectable 40 m.p.h.



POWERFUL MC-6 ENGINE by McCulloch is standard on the 500 Industries' Cub 521 scooter. In deluxe trim, above, it sports headlight, tail light, generator, and fenders. Scooter is available in metallic red or blue finish.

CONTINUED

MAKER OR DISTRIBUTOR	WHERE MADE	MODEL NAME	ENGINE TYPE AND HORSEPOWER	WEIGHT (Pounds)	TRANSMISSION	
American Honda Motor Co. Los Angeles	Japan	Super Cub	2-cycle, 5 hp.	143	3-speed, foot shift	
Ben Hunt Mfg. Co. Walla Walla, Wash.	U. S.	Caper Cycle Road Runner	2-cycle, 2.5 hp.	60	All chain, automatic clutch	
Bird Engineering Omaha, Nebr.	U. S.	Wren Scooter	2-cycle, 2.5 hp.	62	Automatic clutch	
Bug Engineering Azusa, Calif.	U. S.	Flea	2-cycle, 2.5 hp.	70	All chain, automatic clutch	
C & E Mfg. Co. Memphis, Mo.	U. S.	Argyle Scooter Cub	2-cycle, 2.25 hp.	49	Automatic clutch	
Columbus Cycle Co. Columbus, Nebr.	U. S.	Discoverer	4-cycle, 2.5 hp.	85	Automatic clutch	
G. W. Davis Corp. Richmond, Ind.	U. S.	Skat-Kat Jr.	4-cycle, 3 hp.	99	V-Plex automatic	
Glenco Products Fort Wayne, Ind.	U. S.	Little Gen	2- or 4-cycle, 2.5 hp. or 2.25 hp.	50	Automatic clutch	
Hap Alzina Oakland, Calif.	Germany	Playboy	2-cycle, 0.7 hp.	42	Automatic clutch, foot-engaged	
Hawk Tool & Engineering Co. Clarkston, Mich.	U. S.	Special	4-cycle, 2 hp.	160	Wide-ratio automatic	
Louisville Machine & Welding Co. Louisville, Ky.	U. S.	Super-Scooter	2-cycle, 2.5 hp.	55	Automatic clutch, belt and chain drive	
Luther Engineering & Mfg. Co. Pasadena, Calif.	U. S.	Viper Cycle	2- or 4-cycle, 3 hp.	60	Centrifugal clutch	
Luther Engineering & Mfg. Co. Pasadena, Calif.	U. S.	Trail Goat	4-cycle, 3 hp.	130	Centrifugal clutch, chain or belt drive	
Mar-Max Products Salem, O.	U. S.	Lil-Injun	2-cycle, 2.5 hp.	78	Centrifugal clutch	
Midget Motors Corp. Athens, O.	U. S.	Autocycle	4-cycle, 5 hp.	175	2-speed selective	
Montgomery Ward Chicago	Japan	Miami Scooter	4-cycle, 4.9 hp.	237	Automatic clutch	
Montgomery Ward Chicago	France	Riverside Mo-Ped	2-cycle, 2 hp.	121	2-speed automatic	
Savas Sales Owosso, Mich.	Italy	Tourist	2-cycle, 2 hp.	140	3-speed	
Sears, Roebuck & Co. Philadelphia	Austria	Allstate 125	2-cycle, 4.95 hp.	148	3-speed	
Sears, Roebuck & Co. Philadelphia	Austria	Allstate Mo-Ped	2-cycle, 5 hp.	87	Disk clutch	
The 500 Industries Fremont, Nebr.	U. S.	Cub 520	2-cycle, 2.5 hp.	55	Automatic clutch	
The 500 Industries Fremont, Nebr.	U. S.	Cub 521	2-cycle, 7.2 hp.	55	Automatic clutch	
Yard Marvel Mfg. Co. Spokane, Wash.	U. S.	Mountaineer	4-cycle, 3 hp.	125	Automatic clutch	

*Information not available from manufacturer.

cycles, they require smaller engines. This means super gas economy—up to 260 m.p.g.! In fact, it's even hard to measure their stinginess accurately in miles per gallon. Many of the smaller scrimpers don't even carry a full gallon.

Their specialty is the short haul: taking you to the railroad station or to your job a few miles away; whisking Junior off to school; even toting the lady of the house to the supermarket.

Bike or scooter? Years ago, a real distinction was made between power bikes and motor scooters. The former were usually ordinary bicycles with accessory

engines attached. A few were special heavy-duty types built expressly for motor drive. These machines had frames like that of a man's bicycle; a top bar joined the seat upright to the fork support. Many accessory engines were available for bicycle installation. Power bikes were almost always started by pedaling; a lever killed engine compression until the bike had reached a fair speed.

Motor scooters started out as quite a different vehicle. Basically they had smaller, but fatter, wheels and tires. The frame was the step-on type; there was no top bar over which you had to sling a

	WHEELBASE (Inches)	TIRE SIZE (Width & Wheel Dia.)	SPRINGING	PRICE	REMARKS
	46.5	2.25x17	Front and rear	\$245	Lights and horn; electric starter at extra cost.
	33	4.10/3.50x5	None	\$149	Road accessories, higher power at extra cost.
	38	3.40/3.00x5 front 4.00/3.50x5 rear	None	\$100	Lights and fenders at extra cost.
	32.75	6.00x12	None	\$169	Clinton engine standard; also sold less engine or with McCulloch or Yamaha engine; spot brake; no lights or horn.
	29.75	2.80/2.50x4	None	\$169.50	Folds to 14½x18½x22½ in.; lights at extra cost.
	38	4.00x12	Frame, seat	\$129	Lights at extra cost.
	32	3.40/3.00x10	None	\$190	Lights and horn.
	36	4.00/3.50x10	None	\$149	Fenders and lights.
	36	2.25x12.50	Seat	\$127	Electric horn; high-speed gearing optional.
	54	4.00x12	Front	\$167.50	Many accessories available; also sold in kit form and with 3- and 4-hp. engine.
	33	2.80/2.50x4	Seat	\$150	Bicycle-type seat.
	37	4.10/3.50x5	Front	\$159	Kits, many accessories, various drives available.
	38	4.00x8	None	\$275	Rear luggage space; front and rear springing, two-speed transmission at extra cost.
	36	4.00x6	None	*	Available in kit form; plans \$2.50.
	47	4.50x6	Front	\$295	Front, rear, and stop lights; disk brake; 12-volt electrical system with electric starter.
	55	4.00x8	Front	\$287.50	Electric lights; enclosed engine.
	46	2.25x22.50	Front and rear	\$179.50	Front and rear brakes; lights and horn, speedometer, luggage rack, tools; can be pedaled.
	44	2.25/2.00x23	Front and rear	\$229.50	Front and rear brakes; lights; can be pedaled.
	46	2.75x16	Front	\$289	Light-motorcycle type; lights and horn.
	46	2.25x23	Front and rear	\$189	Front and rear brakes; horn, lights, and speedometer; can be pedaled.
	34.5	4.10/3.50x4 front 4.10/3.50x5 rear	None	\$130	Lights, fenders, generator at extra cost.
	34.5	4.10/3.50x4 front 4.10/3.50x5 rear	None	\$220	Lights, fenders, generator at extra cost.
	45	4.80x8	None	\$249	Geared to climb; road gearing and dual-speed transmission available.

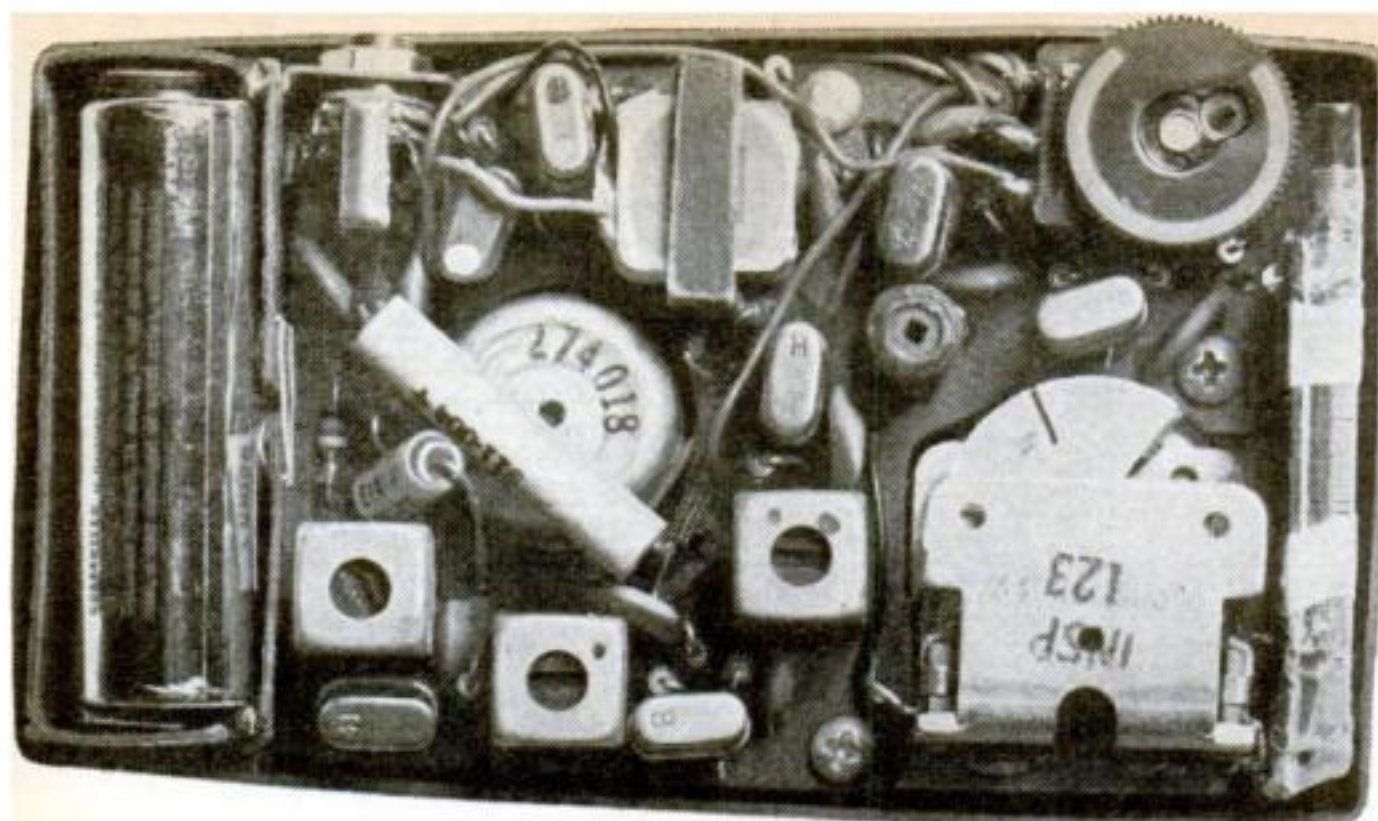
leg. Scooters couldn't be pedaled, so engines were equipped with a pull-cord or kick-type starter.

Nowadays the two have merged to such a degree that it's often hard to class them. Because of the current trend toward ultra-light bicycles, power bikes in their traditional form have all but died out. The light frames and wheels of modern bikes don't take to the strain of motor drive. Probably the easiest way to classify today's crop of small two-wheelers is by the wheels. If they're of large diameter and have wire spokes, it's a power bike;

[\[Continued on page 170\]](#)

OFFSPRING of the popular kart, Bug Engineering's Flea comes with choice of three engines—or, for \$144, without engine. It has aluminum wheels, motorcycle throttle and brake grips, and double-size foam-rubber padded seat.

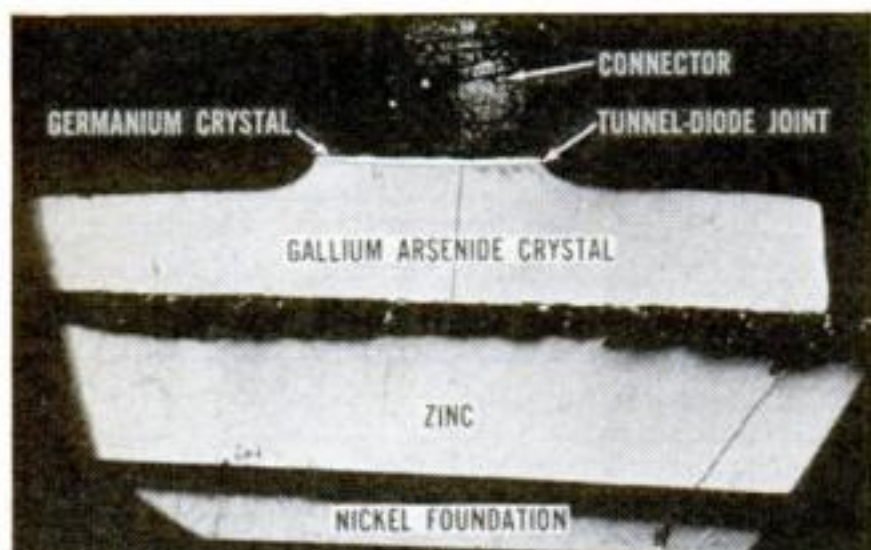




This is what it takes to make a conventional 7-transistor portable radio

How They'll Grow

New technique may create radio and TV receivers all in one piece —each a single block of crystal containing no separate parts



INSIDE AN ELECTRONIC CRYSTAL: This is a tunnel diode, sectioned and magnified 260 times. Complicated "function blocks" look much the same—the difference is in their atoms.

By Martin Mann

OF ALL the fantastic inventions of the guys who play around with transistors, the latest is the wildest and most wonderful. They are going to grow radios, TV sets, and other electronic gadgets as they grow tomatoes or carrots.

Their crop will be tiny, shiny specks of crystal. Each crystal will be the works of a radio, say. Not one part for a radio circuit, but the whole thing. There will be no parts—just a single solid crystal. You'll still need loudspeaker and knobs



SEVEN ON A DIME: Texas Instruments' solid-block multivibrators (used in electronic computers) are 1/100 of the size of conventional units, which require 16 separate parts each.

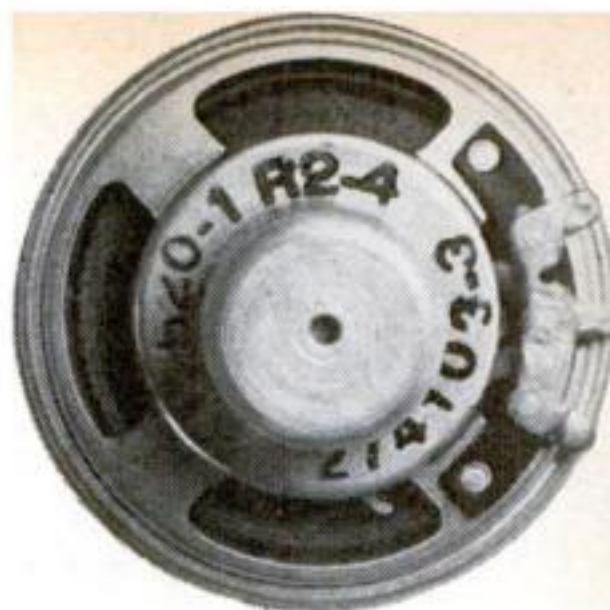


SOLID-BLOCK AMPLIFIER (just visible directly beneath sign) boosts output of solar cell in front of flashlight. Cell gives .004 amps, amplifier delivers 40 amps to run headlights.

Today it can be boiled down to this . . . ultimately there'll be only one solid block and the knobs



Tuning, volume, and sensitivity controls



Eight solid electronic blocks are the works of this radio

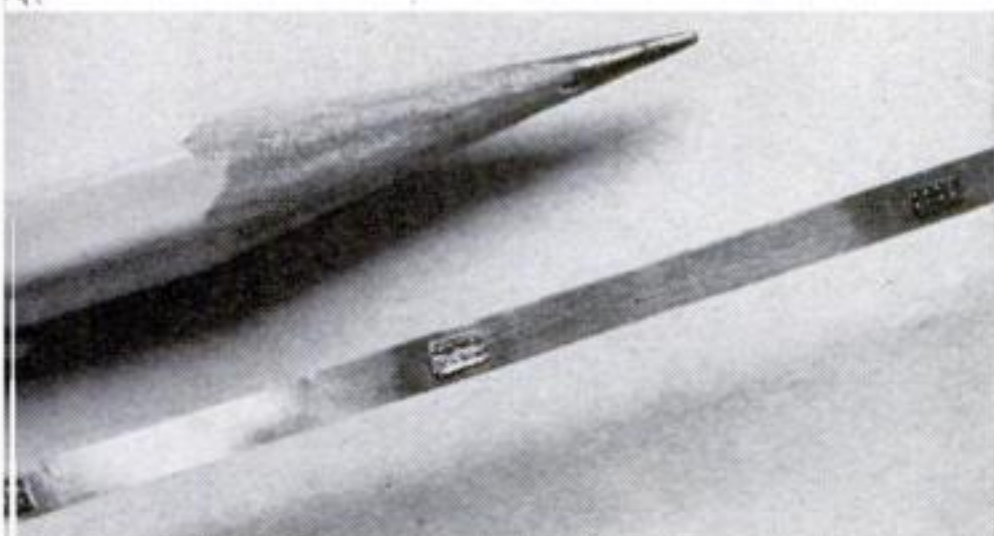
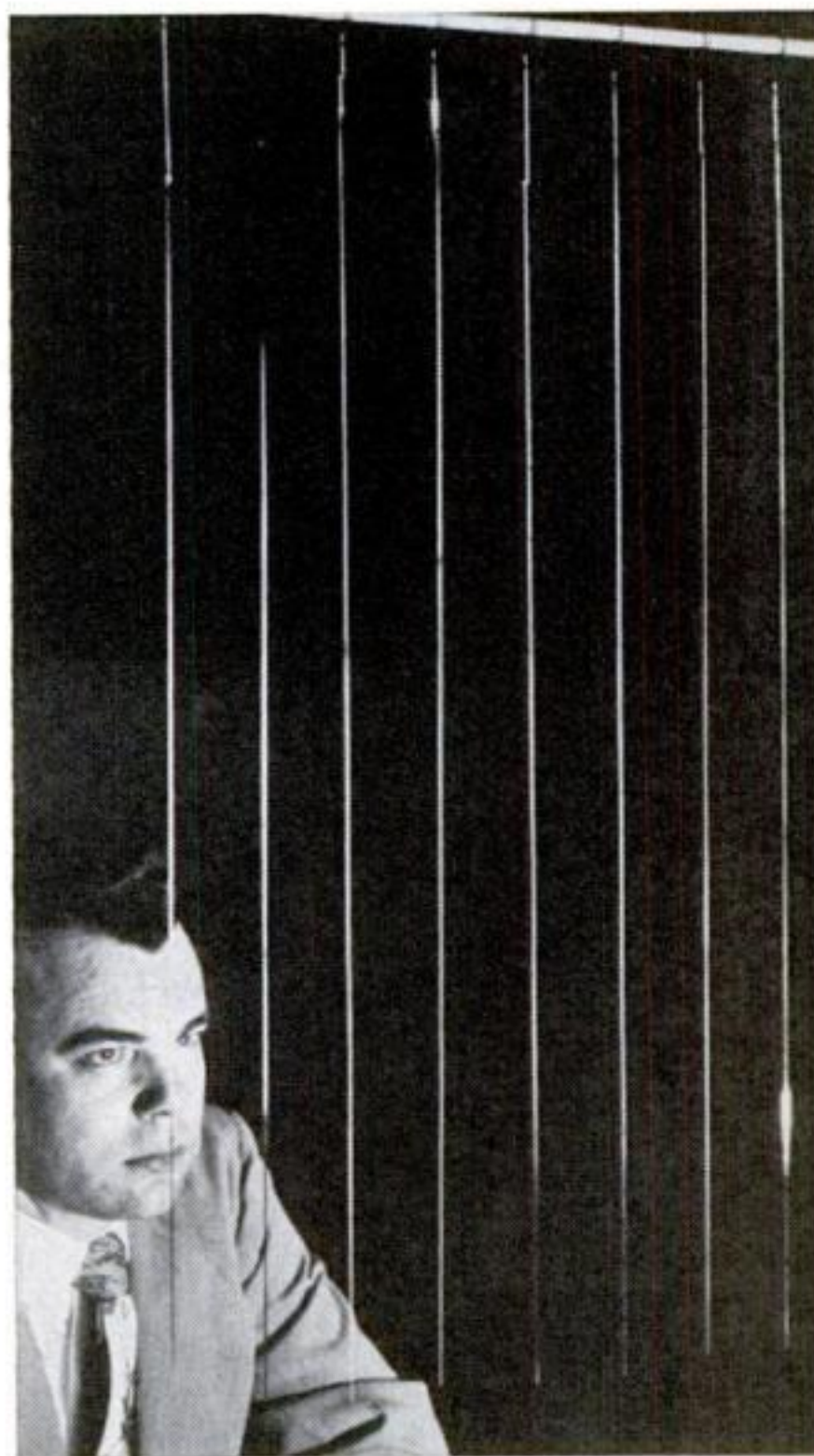
TV Sets Like Tomatoes

on the front, antenna and maybe batteries at the back—but in between only a crystal “radio block.”

That solid block will do everything that now requires 50 separate parts: half a dozen transistors, dozens of resistors, condensers, and coils, and a maze of metal-ribbon connections. A radio signal will come in the back of the block, and audio power for the loudspeaker will come out the front. It will be so small it will look like a rivet on the loudspeaker frame.

Does this sound as if some press agent has been belting his expense-account bourbon too hard? The fact is, the first crude versions of these miraculous buttons have already been made.

Last winter, Westinghouse engineers



SMALL RECTANGLE in center of ribbon is a solid function block. It is a precisely controlled combination of several materials created on the ultra-pure, ribbon-shaped germanium crystal.

LONG SHINY RIBBONS are perfect electronic crystals—each atom in its proper place—grown by “dendritic” process. Some function blocks can be produced direct from the melt in this way.

CONTINUED

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The big bonus: reliability. With just one part and few



ELECTRONIC CRYSTALS grow from a pot. As dendrite ribbon is pulled out of the melt, germanium atoms freeze in an exact pattern. Each ribbon can be diced into many individual units.

demonstrated a small radio. They couldn't quite make it in one block—not yet. They used eight. The Air Force has ordered a high-frequency communications receiver built the same way. And Texas Instruments, the transistor tycoons from Dallas, are already selling their Type 502 multivibrator. This gismo for a computer, so small you can barely read the trademark, does what formerly required 16 separate parts.

It will be a couple of years before gadgets you can use show up in the appliance stores. But when they do, you'll know a real revolution has come. This revolution means:

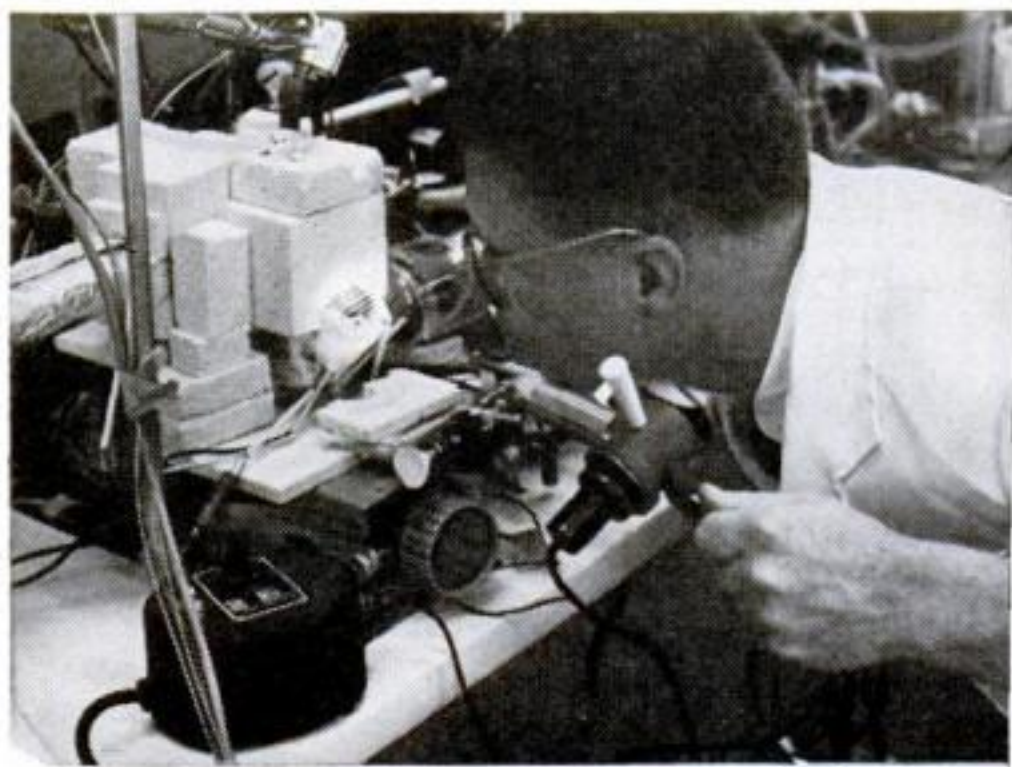
- **Handy size.** TV sets might be no bigger than picture screens, and these could be flat as a book. The personal radio would shrink under wristwatch size and become part of the watch, controlling the timekeeper as well as furnishing music; it might need no battery, making its own electricity from the warmth of your wrist. Really smart electronic computers might become small and cheap enough to drive your car or control household appliances.

- **Economy.** The all-in-one blocks just naturally come in big quantities. You grow one giant crystal, then dice it; each bit could be an entire radio chassis or computer circuit or whatever. The process has to be automatic (no human can manage it), so it should be cheap—eventually.

- **Long, trouble-free use.** About the only thing likely to make a solid-block radio or TV go dead is a small boy with a hammer. A solid unit doesn't burn out; there are no interconnecting wires to come loose; and—most important—reducing the number of parts automatically cuts the chance that anything will go wrong.

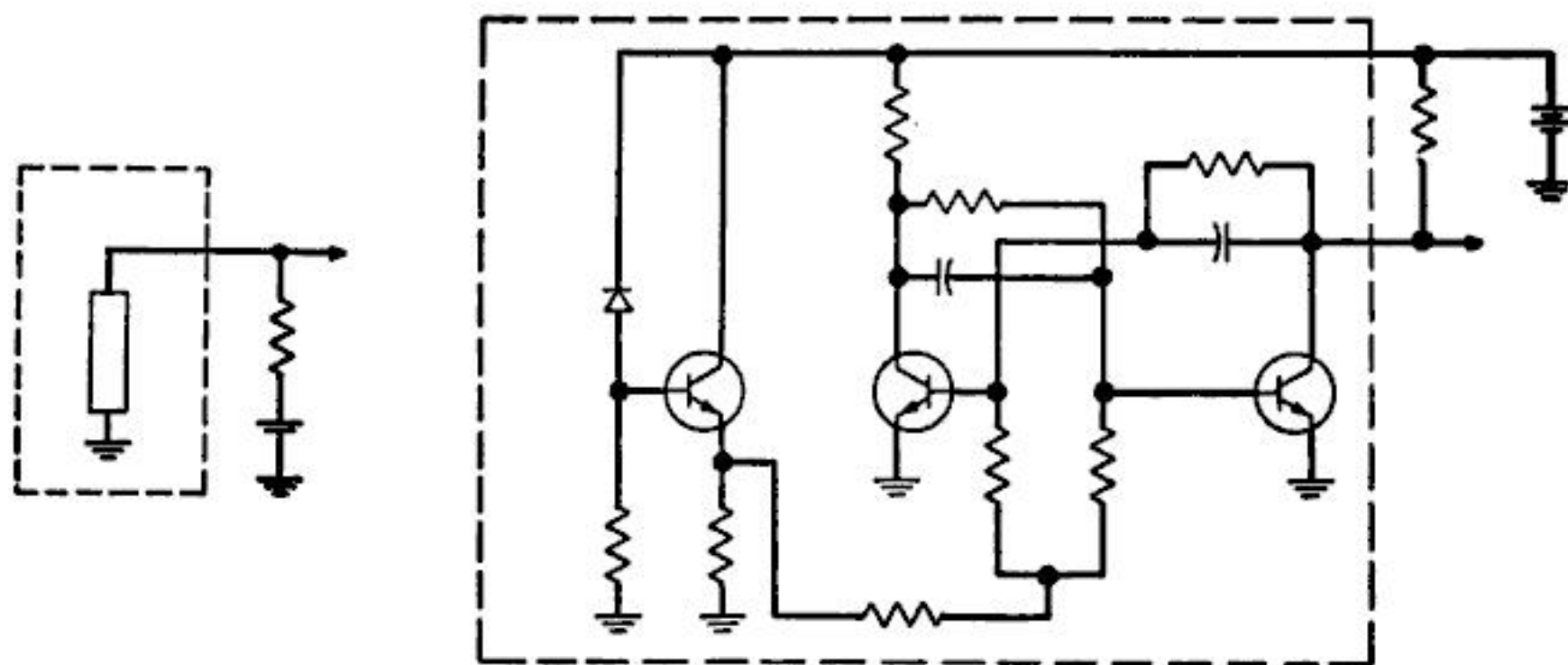
- **No repairs.** You won't be able to fix one of these things because there will be nothing to fix. You'll throw it away, like a torn Dixie Cup. (Servicemen may be automated into the ranks of the technologically unemployed. Who needs an expert to replace faulty parts when there's only one part to replace?)

If this sounds good to you, it sounds even better to military men. What excites them most is reliability. Complexity is the reason many missiles go haywire. With so many parts, one or another is almost bound to fail. Reducing the number of parts is a much more effective route to sure-fire operation than trying to improve the parts—some individual components are already specified for



VAPOR SPAWNS CRYSTALS as IBM scientist watches. In process, gaseous compound moves to cooler part of chamber, where it freezes on a solid seed to grow a big, perfect crystal.

connections, an electronic block should work every time



ELECTRONICS GOES COMPACT: Great reduction in size and complexity of above system (for light measurement) typifies revolutionary

changes function blocks bring. Job that took 14 parts, 15 joints, $\frac{3}{4}$ -watt power (right) could be done with single part, 2 joints, .06 watts.

99.993-percent reliability (no more than seven hours of failure in 100,000 hours of operation).

The tremendous savings in size and weight that the solid blocks will bring is just as valuable. We'll be able to send up bigger loads with less powerful rockets.

Beyond that, an awesome prospect comes into view. These magic blocks of crystal come close to matching human brain cells. For the first time, it really seems possible to build an electronic computer that will be as smart as a man: a black box not much bigger than a man's head and able to do the same things as his head. Such a development alternately delights and scares the pants off the philosophers.

People who know something about electronics often miss the revolutionary character of these solid crystal blocks. They know that resistors retard electricity, that transistors boost electricity, that combinations of resistors and condensers cause electricity to surge back and forth. So they think that the solid blocks are just a new way to make extremely tiny resistors, condensers, transistors, etc., and cram them into one small package. That's not the idea.

Coming closer. Then they think that somebody has figured out how to treat different sections of a solid crystal so one section is a resistor, another section a condenser, another a transistor, and so

on. You would still have the familiar old components but mapped out on one single crystal instead of sticking up separately on a circuit board. The crystal becomes a complete circuit instead of one part for a circuit. That's closer. Texas Instruments uses this technique for its solid circuit multivibrator.

Yet even that is not the full flowering of a radical and beautiful idea. Forget about resistors, condensers, transistors, and even about circuits. There aren't any. All you have is a shiny gray block of unbelievably pure silicon or germanium into which have been squirted a few atoms of tin, zinc, or phosphorus. This block is designed from the beginning to perform a "function."

If it's a radio block, it takes in (from the antenna) a very weak current that varies in a complicated way and gives out (to the speaker) a powerful current that varies in a related, but simpler, way. You can't point to the block and say that the RF amplifier is here, the detector there, and the audio amplifier some place else. They are spread through the block. If you slice the block in two, you have two radios, each less powerful than the original. You can keep right on slicing, cutting off additional radios of less and less power. (There is a limit, of course; you end up with slices containing too few of the atoms needed to perform the radio function.)

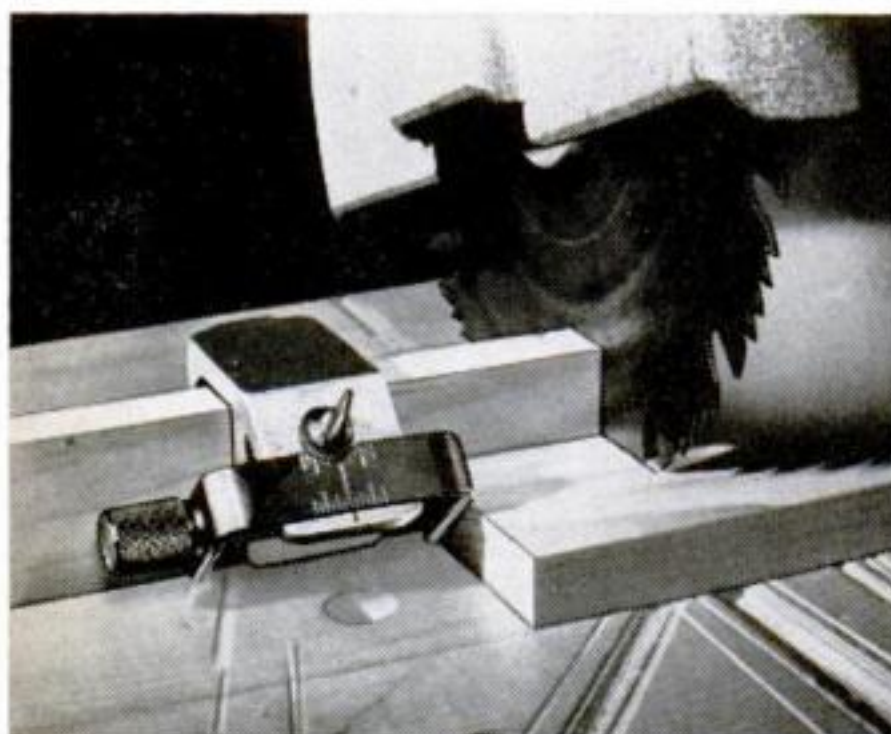
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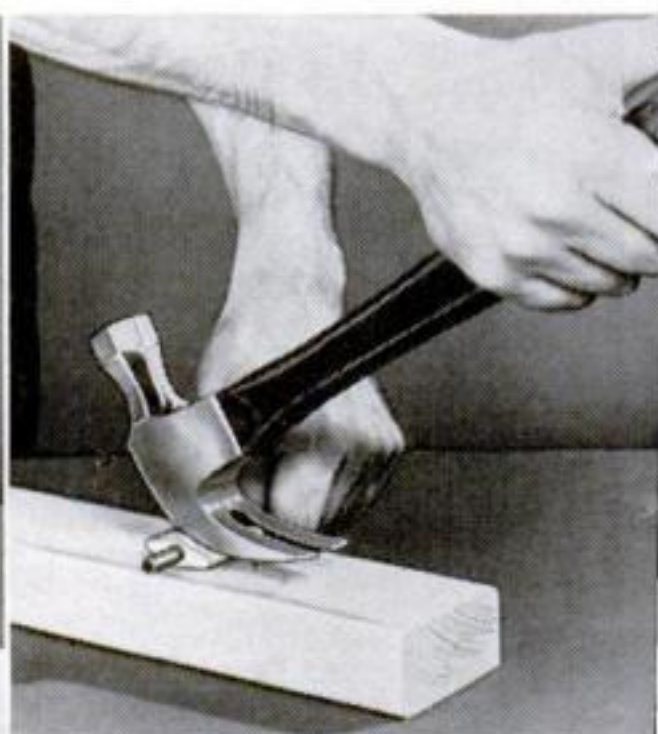
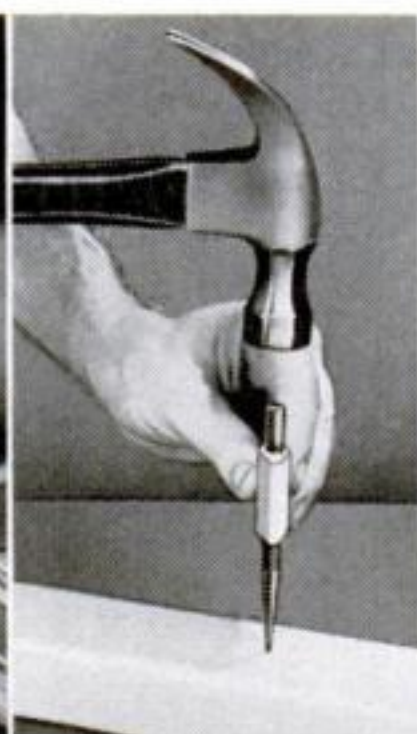
Floating Furniture for Pool

You can now get a chaise longue that will float in your swimming pool. It's made of aluminum tubing and woven Saran webbing. Instead of resting on legs, it has adjustable plastic-foam floats. Floating accessories include a card or

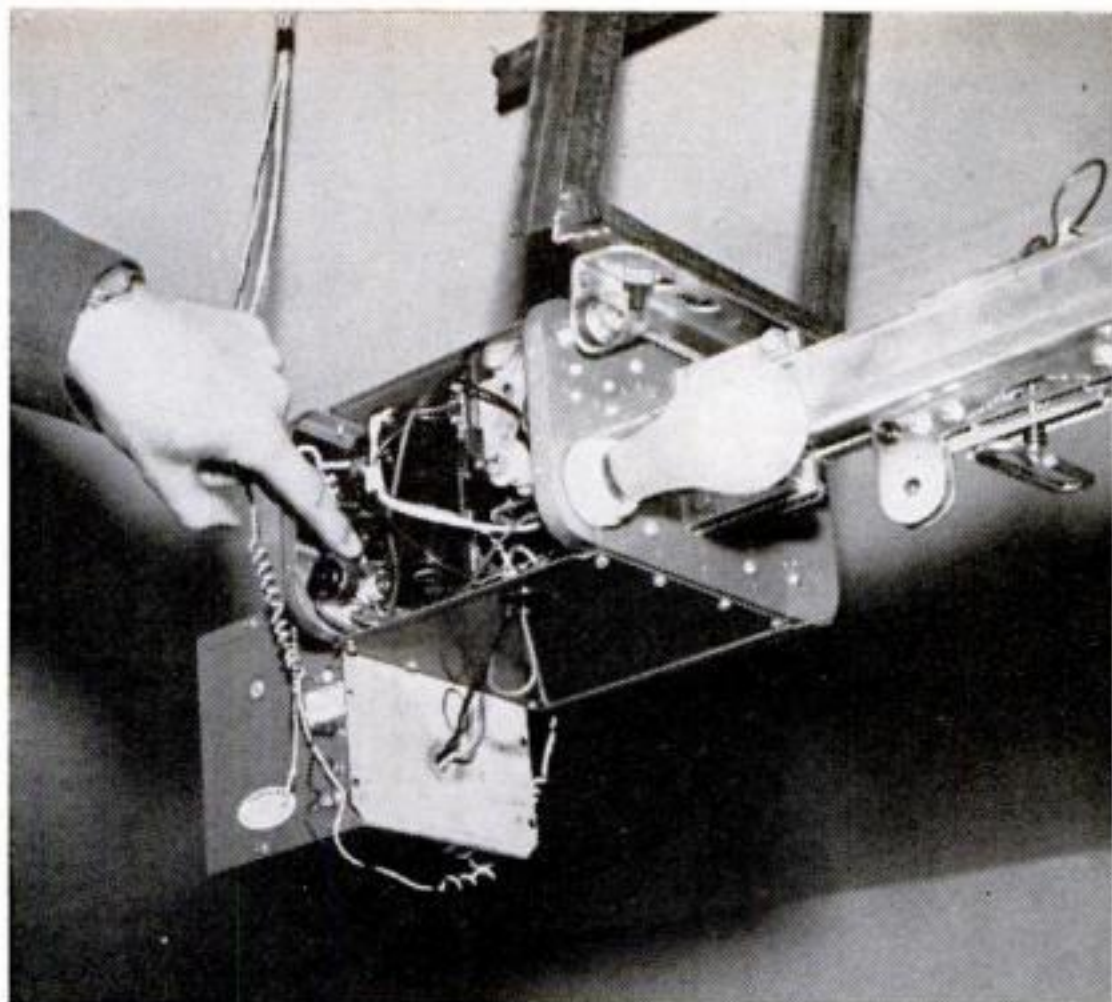
coffee table, "butler" recessed to hold glass and ash tray, and custom-made bar. Aqua-Lounge sells for \$29.95; Aqua-Table, \$7.50; Aqua-Butler, \$6.95; and Aqua-Bar, \$150 to \$1,000. CeeCee Enterprises, 1565 India St., San Diego, Calif.



ADJUSTABLE STOP GAUGE is an aluminum attachment for bench and radial saws. A thumbscrew locks it to a one-by-two wood fence. You set it to the precise length to be cut by turning a knurled knob that moves a steel bar on a scale graduated in $\frac{1}{16}$ -inch markings. The stop can be used on either side of the blade. It costs \$5.95. L. Stahl, 3166 Wadsworth, Saginaw, Mich.



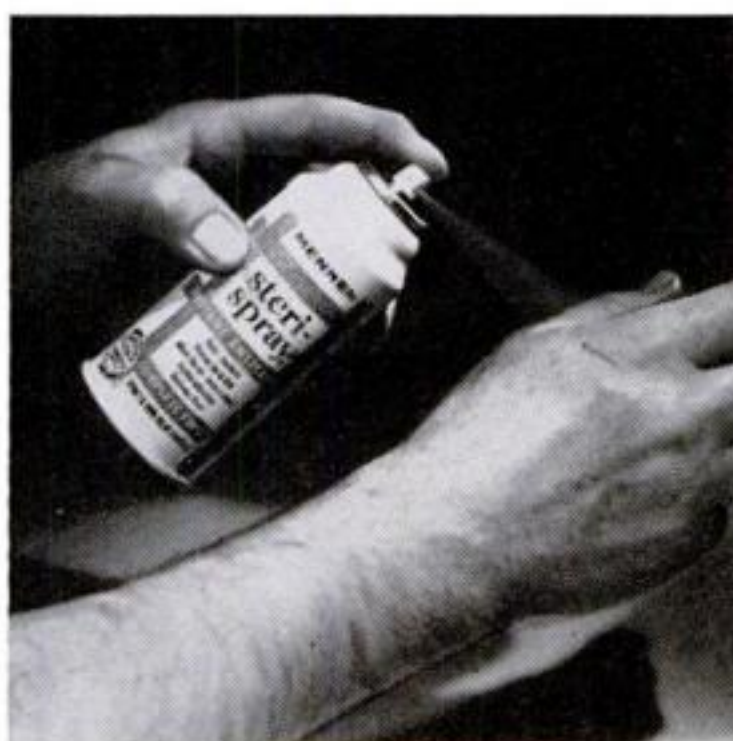
NAIL-PULLING NAIL SET has a wedge-shaped hard-rubber pillow around its shank. Used as a safety grip, the rubber takes the sting out when you are setting nails. As a fulcrum under the head of a claw hammer, it's a soft cushion that permits you to pull out nails without marring the surface of the work. The Better Setter is priced at 59 cents. Gordon Mfg. Co., Farmington, Conn.



DELAYING SWITCH (finger points to it in photo) keeps the garage light on for two minutes after you close the door to give you time to get in the house. Genie Switch can be installed also in the control box of automatic door openers other than those of its maker. \$5.95. The Alliance Mfg. Co., Alliance, Ohio.



CLEANING FLUID—a blend of two Du Pont Freon solvents—lets you dunk and clean a motor while it's running. Nonconductive, nonflammable, and non-toxic, it removes dirt and grease without harm to insulation. Eight-ounce bottle of En-Irt costs \$1.70. Kyle Products Co., 2207 Old Orchard Rd., Wilmington, Del.



SPRAY BANDAGE is antiseptic liquid plastic in an aerosol can. You spray it on minor cuts, scrapes, or burns to form a seal and relieve pain. Steri-Spray is good also for poison ivy, sunburn, and insect bites. Cost, \$1.69 a can. Mennen Co., Morristown, N. J.



RASPING PLATES fasten on spindle for chucking in a 1/4-inch drill. The five-inch steel disks are made with faces of three types: medium, coarse, and combination. Each, \$1.98, or all three for \$5.75. Alexander Sales, 140 Marbledale Rd., Tuckahoe, N. Y.

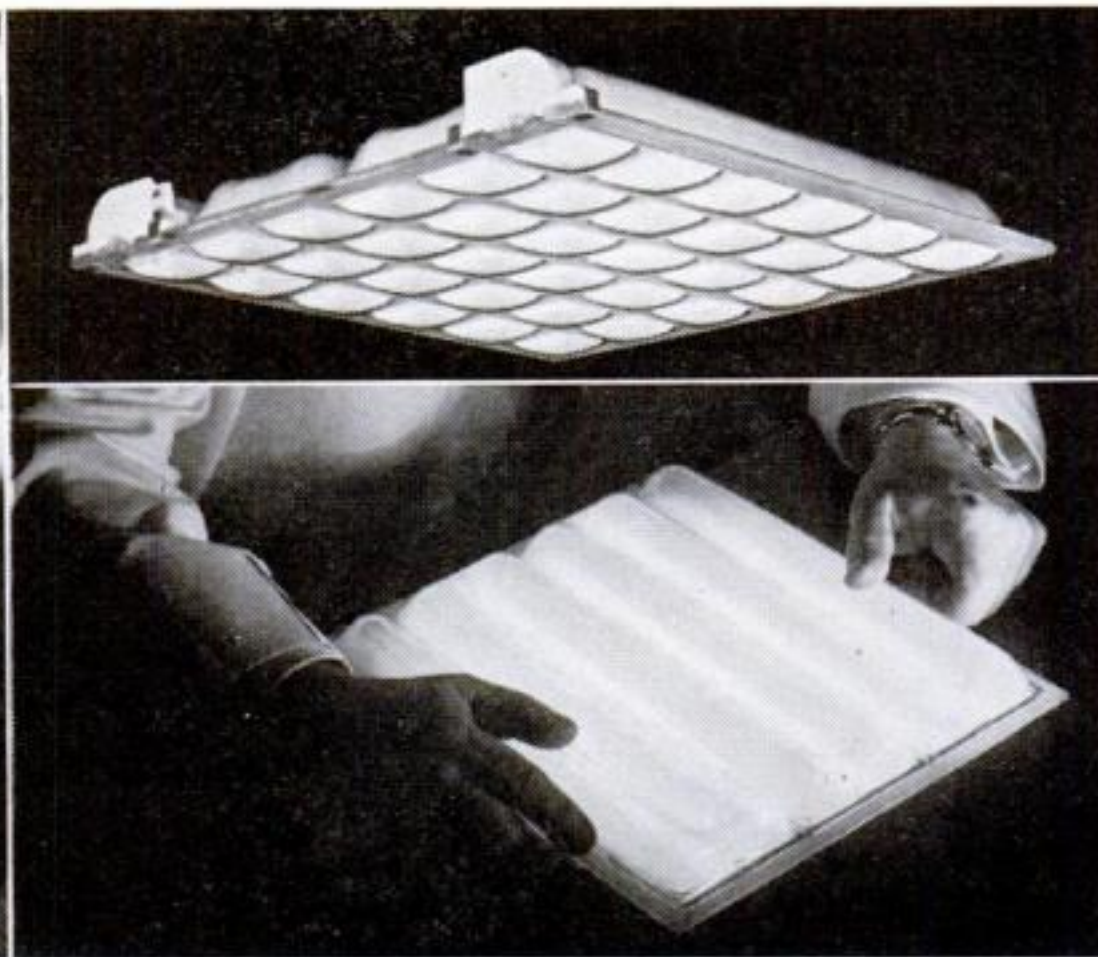


REDWOOD STAIN contains ultraviolet filter that screens out rays of sun and makes outdoor furniture and woodwork wear better. Quart, about \$2.50; gallon, \$8. Clear gloss for finish is about \$3.75 a quart, \$13 a gallon. Sapolin Paints, Inc., 205 E. 42 St., NYC.

WHAT'S NEW.....



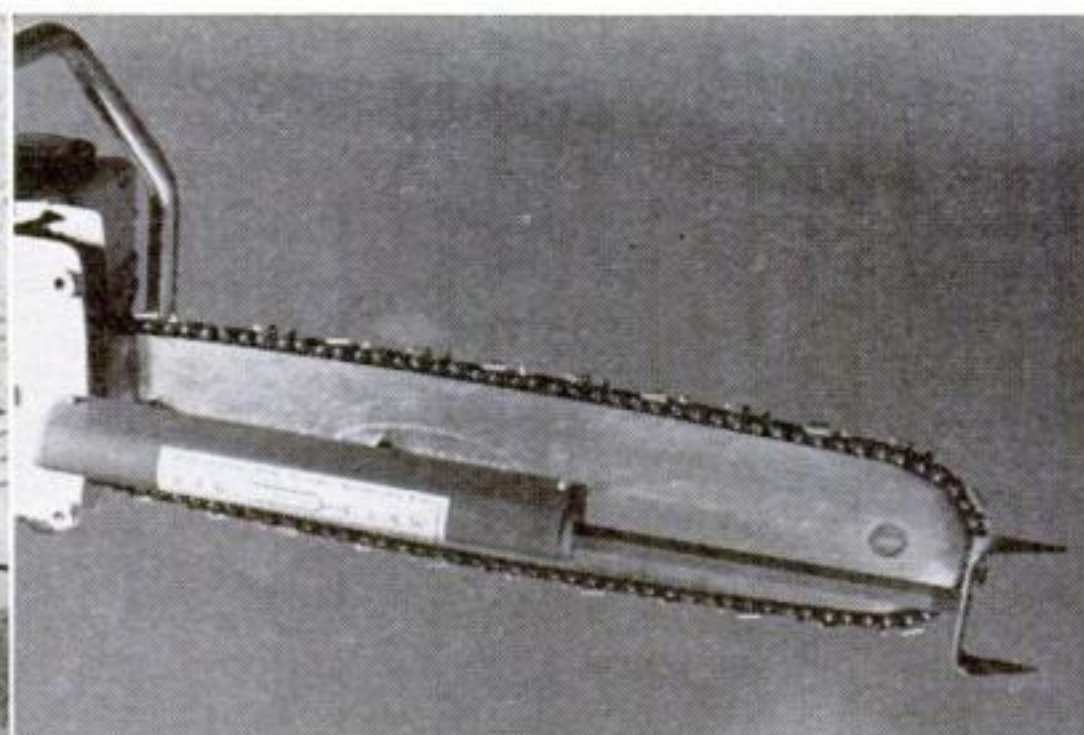
LIQUID MEAL is a substitute for breakfast or lunch when you can't take time out to eat. Not a diet food, each 12½-ounce can contains fat, carbohydrate, protein, vitamins, and minerals, adding up to 400 calories. Nutrament, chocolate or vanilla, costs 39 cents a can. Edward Dalton Co., Evansville, Ind.



WAFFLE FLUORESCENT has five feet of tube in wormlike convolutions behind a grid face. The panel lamp is 1½ inches deep, fits in 12-inch-square ceiling recess, and operates at 50 or 80 watts, giving more light at 80 than four conventional 20-watt tubes. \$6.95. General Electric, Nela Park, Cleveland.



CONCRETE-PATCH KIT includes all materials and tools you need for a repair around the house. Cement and sand blended with chemicals for waterproofing, bonding, plasticizing, and hardening are contained in a vinyl bag. Bag, with trowel and mixer-edger, is packed in a plastic mortar box. Two sizes: 2½ pounds, \$1; 6 pounds, \$2. Instant Crete, 1134 E. St. George Ave., Linden, N.J.



SAW-CLAW is a double-pronged, spring-loaded steel bar that mounts on the guide bar of a chain saw. It supports the weight to keep the saw steady as you prune limbs, slash brush to the ground, or nose-cut slots or mortises in fence posts. The bar lets you move the saw forward and backward; the claw keeps it from walking or twisting. \$11.75. Glenford Mfg. Co., Glenford, N. Y.



Unsinkable Plastic Sports Kayak

This plastic dinghy has air compartments fore and aft of the cockpit to give buoyancy. It's molded of Marlex polyethylene impregnated with permanent color. Seams are heat-sealed to make them leakproof. The Sportyak is 7 feet

long, 29 inches wide, and 12 inches deep. It weighs 20 pounds, will carry a 250-pound load. You can lift it without help onto a car-roof rack or stow it in the trunk. \$59.95. Dayton Bait & Marine Products Co., 2701 S. Dixie Dr., Dayton, Ohio.



WINDSHIELD WASHER shoots a stream under foot pressure. A pump independent of the car's vacuum or electric system spews water from adjustable jet nozzles. A multiposition bracket keeps the reservoir upright on slanted surface. Big Shot is made for U. S. cars and trucks, and for foreign cars with limited underhood room. Either size, \$10.85. Anderson Co., 1075 Grant St., Gary, Ind.



TWO-SPEED DRILL runs on a balanced motor that, the makers say, adjusts automatically to 1,500 r.p.m. when you are drilling a 1/4-inch hole in metal, to 1,050 r.p.m. when you meet greater resistance in a 3/8-inch hole. It will drill up to one inch in wood, and is powerful enough for stone, tile, or concrete. Duo-Drill is \$27.95. Cummins Portable Tool, 5055 N. Lydell Ave., Milwaukee.

WHAT TO DO When a Boat Capsizes

By George Daniels

A TRIM little outboard utility swings around in the afternoon sun. A passenger hoists himself to the back of the seat. A sudden wave throws him off balance. He grabs a gunwale as he pitches outward—and over she goes. For a moment only white foam surrounds the capsized hull. Then, one by one the passengers bob up around her. Accidents

like this bring about the loss of many lives each year.

When a boat swamps, the shakeout, a technique originated by canoeists, can be used to empty the water from it. You can try the principle at home.

Float a wooden bowl in a dish pan. Fill the bowl to the rim with water and it will float like a swamped boat, almost sunk. Now give it a push with your finger, bearing down slightly on the pushed



1. The first and best rule: Stay with boat

AN OVERTURNED BOAT, or one filled with water, usually makes a fine life preserver. Wood construction or flotation material will keep it afloat

indefinitely. Staying with it boosts rescue chances; a boat is much easier for rescuers to spot in the water than lone swimmers.

3. Or perhaps you can right it...

A ROLL-OVER is accomplished this way: Push down on near side with hands and feet, and

grip opposite gunwale as it rises. When half over, the hull will complete roll by itself.





2. Sometimes you can push boat to land

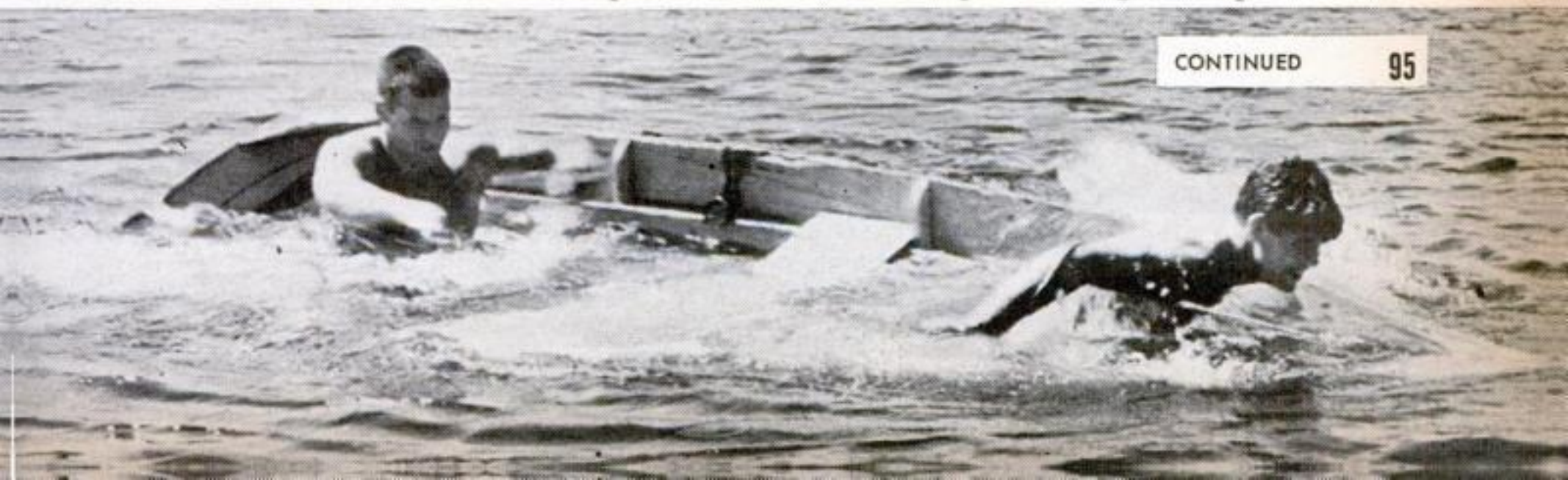
A GOOD SWIMMER can grip the stern of a cap-sized boat and kick for shore. To steer the

boat, swing your body—as you would an out-board motor. Progress is slow—but safe.

...climb in, and paddle ashore

SWAMPED BOAT will keep all heads above the water. Swim into it. Use hands to paddle for-

ward. Stroke downward for a balancing effect if the swamped hull begins to tip.



CONTINUED

95



4. Or you can rock the water out of the boat

THE SHAKEOUT is a method of emptying a swamped hull in deep water. First, give the stern a downward and forward shove. Bow will rise (1), spilling out water. Stern will then rise, bringing some water with it, but not the full load. Rock and roll is next step (2). Man at left shoves down and away on his side of hull, releasing pressure as outward slosh of water slows. Man at right then gives down-pull and shove outward in same way to bring more water over his side. Rhythm of shake-out must be timed to roll of water in hull. Freeboard increases rapidly. In this picture (3), taken only 15 seconds after preceding one, man at left appears to be standing on bottom but is actually in 15 feet of water, lifted by down-push on boat. For final stage, breast into boat over transom, and bail or splash water out. If your balance is good you can use paddles or oars (4). If not, sit down in center and splash out remaining water with hands.



side, and much of the water will slosh over the side. Repeat the process a few times and the bowl is practically empty. Notice that timing your push to the roll of the water in the bowl is more important than the power of the push. The same is true when you shake out a boat.

With a very light boat, you grip the stern with arm flexed and knees drawn up for a propulsive kick and a shove.

Even a slow movement of the swamped hull brings a swell of water over the transom. From here on, depending on the boat, shove it sideways or lengthwise, tipping to slosh the water out.

Simple bailing is possible with many rowboats, skiffs, and similar hulls. Simply oreast aboard the swamped boat and kneel on the bottom amidships. If the rim of the hull (gunwales and transom)

2



4



remains even slightly above the surface, you can bail it out. One advantage of this procedure: You can help others into the boat when it's floating high.

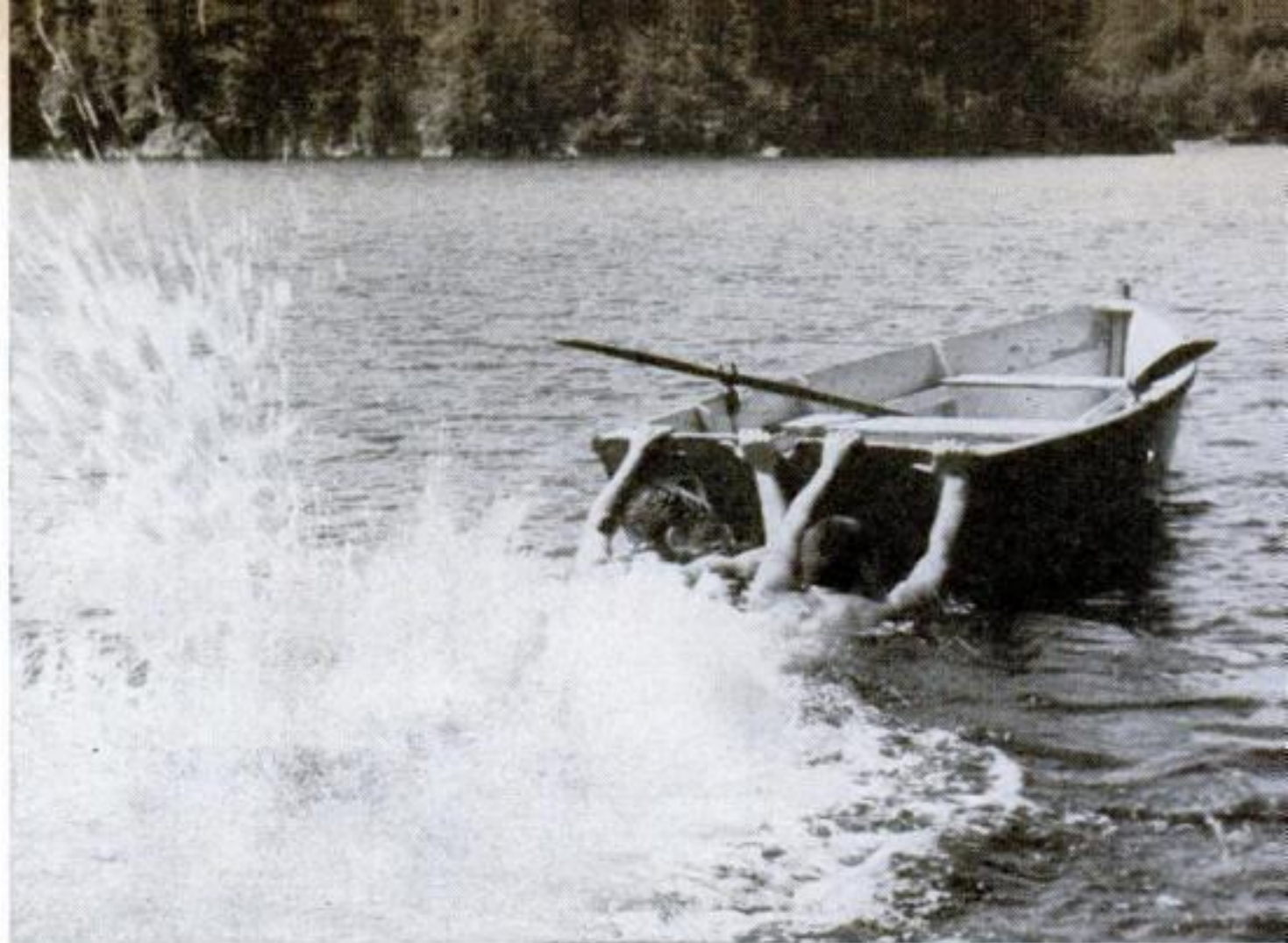
Reboarding from the water. Always come in over the transom if you can, even alongside an outboard motor, as you'll tip the boat far less.

If you must come in unassisted over the side of a narrow boat, hold the gun-

wale with one hand and a seat or thwart with the other, pulling your upper body up and in as quickly as possible, aided by a sharp kick. If you turn your body as you go over the gunwale you can swing your legs in almost instantly, centering your weight. If you're fast enough, the gunwale may even dip under slightly and rise again without taking on a serious amount of water.

5. Once empty, boat is easy to push

SWIM PROPULSION of an empty boat makes for remarkably fast headway, a fact to remember if you simply fall overboard—or if you find it difficult to get in after going through a shakeout.



6. Tips on getting back into a boat



OVER THE TRANSOM, when this is possible, is the safest approach since it minimizes tipping. Grab the transom with both hands, lunge down until your shoulders are under water, give a strong kick and pull upward until you can bend

YOU CAN BOARD OVER GUNWALE on most skiffs, runabouts, and rowboats if transom is blocked. Lunge down to shoulders. As rise begins, start strong leg kicks, pull up with hands on gunwale,



into boat at hips. Let your upper body down into boat, legs up. Finally, bend your knees to bring your legs in, and roll over, settling into bottom of boat. A second person can hold onto the boat to help steady it while you clamber in.

and start turning your body. The rising turn and release of right handgrip on gunwale brings you into the boat as in photograph below. Lean back slightly to keep boat from tipping.





Detroit influence shows in quad lights, plunging hood line, and wraparound windshield.

Four-eyed Consul

This New English Ford, the Consul 315, is powered by a longer-stroke (but still oversquare) adaptation of the Anglia engine, with displacement upped to 81.78 cu. in. and output to 56.5 hp. Four-speed transmission comes with floor stick or lever on the steering column. The five-seater has disk brakes on front wheels, variable-speed electric wipers, and stratified heating—fresh air on the face, warm air on the feet.

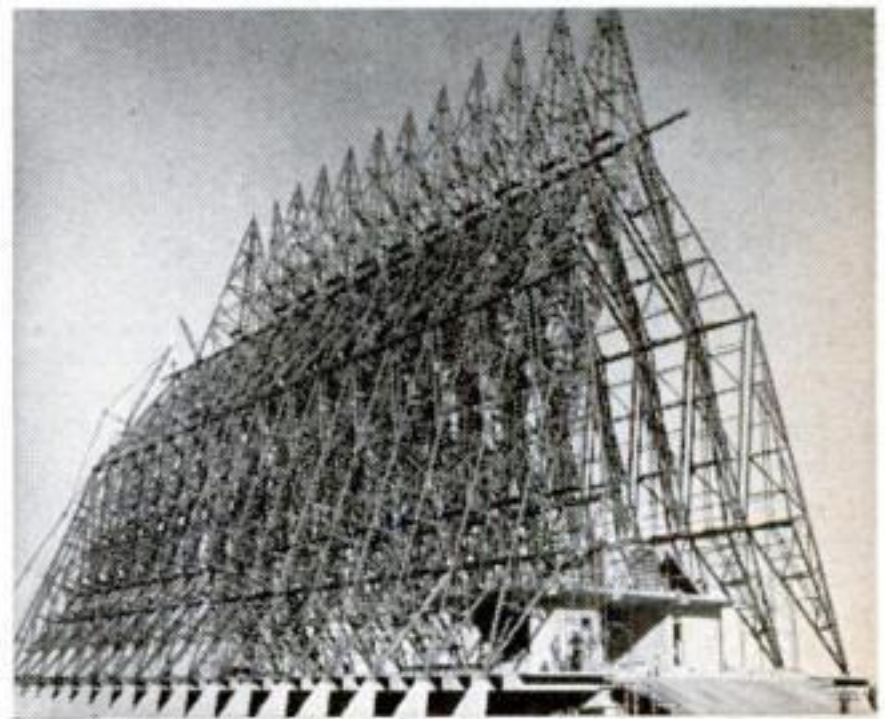


REVERSE-SLANT REAR WINDOW is trailed by 21 cu. ft. of trunk space with a wide-opening lid.



Railroad adaptor on crane

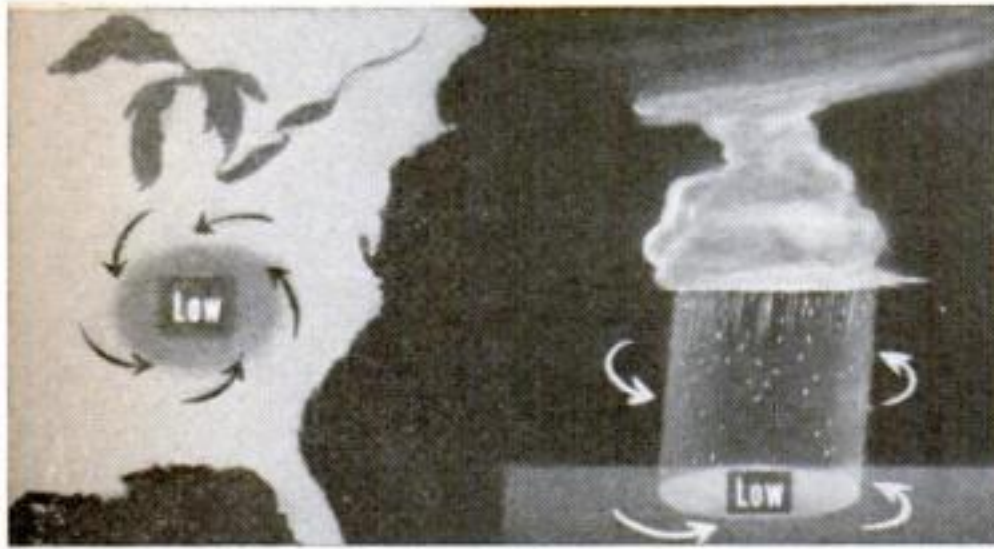
A new highway crane can be converted in minutes for use on railroad tracks. The crane is driven into position over the rails; a hand crank at either end then lowers front and back flanged wheels into position and jacks up the rubber-tired wheels. The crane was designed by Harnischfeger Corp., Milwaukee, as a double-duty replacement for flatcar cranes.



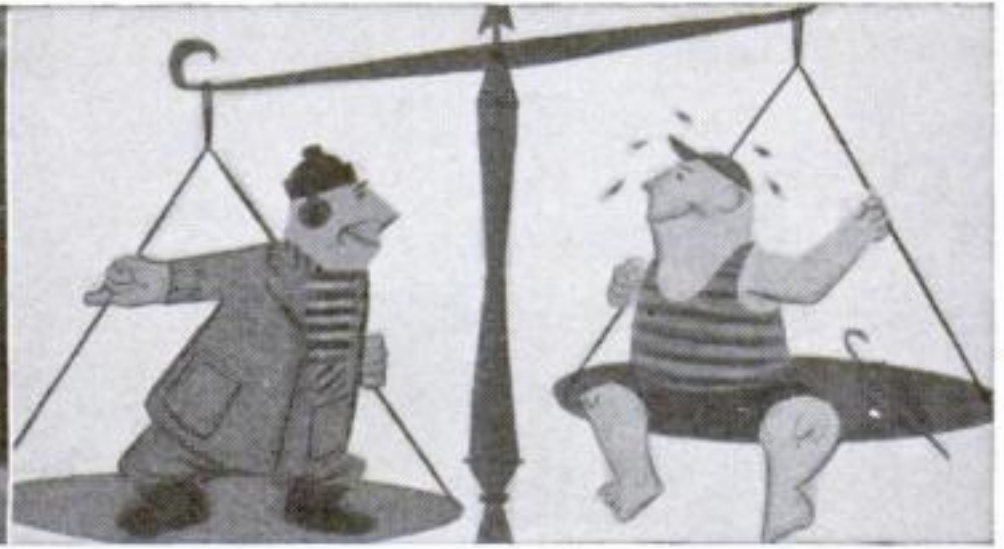
Many-steeped church

Welded four- and six-inch steel pipe forms the framework for the modern Gothic chapel being built at the Air Force Academy in Colorado Springs. Wedge-shaped sections, 75 feet long, were prefabricated and shipped to the site where they were assembled for the 150-foot-tall structure. When the skin is put on, the chapel will have 17 spires.

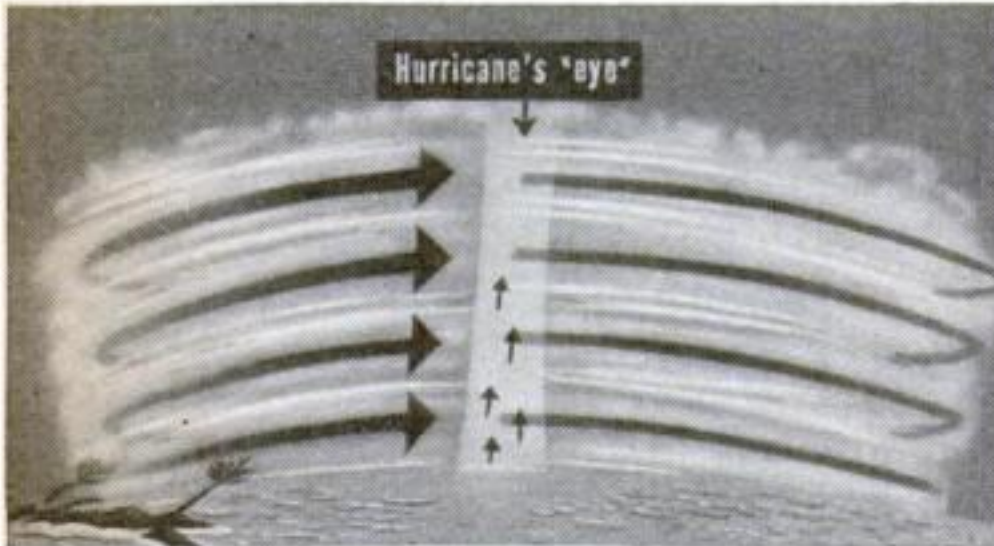
What Makes a Hurricane?



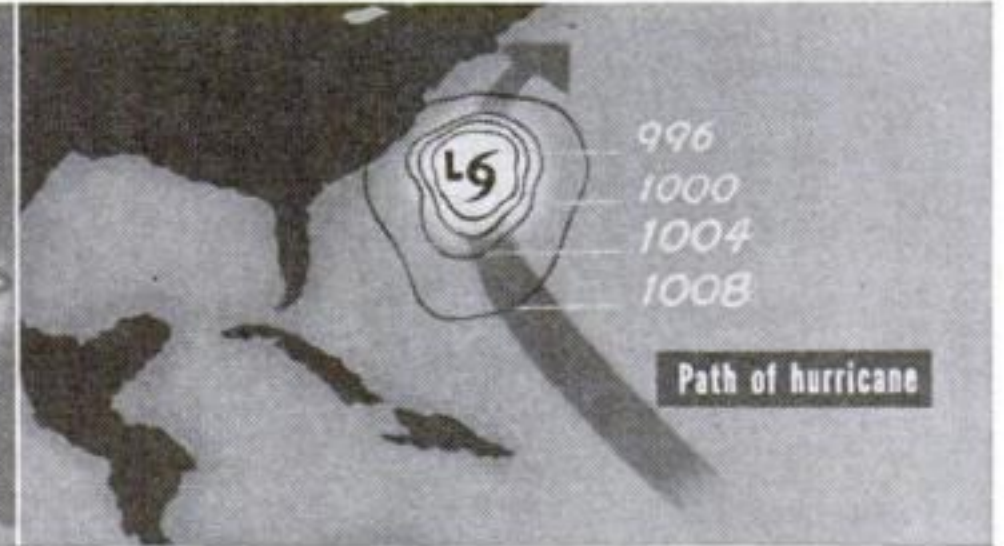
To understand hurricanes we must first know what causes wind. Rising warm air creates a low-pressure area. Air from surrounding high-pressure regions rushes in.



Air turbulence is caused by the difference in densities between the two fronts. Warm, moist air is lighter than cold, dry air, and tends to rise.



A vicious circle is created by the rising air. As the spinning of the updraft becomes faster, more and more moist air is continually drawn in and pulled up.



As more moist air enters, pressure drops still further. As long as it's over warm water, the hurricane continues to grow. It weakens over cool water or land.

Tornado: Hurricane's Vicious Small Cousin

Tornadoes are usually accompanied by thunderstorms. A mass of moist air; a layer of warm, dry air over it; an invading cold front—and the fearsome twister may form. Several may attack at once. Even if they're spotted by radar, their great cross-country speed—up to 60 m.p.h.—allows little time for warning.

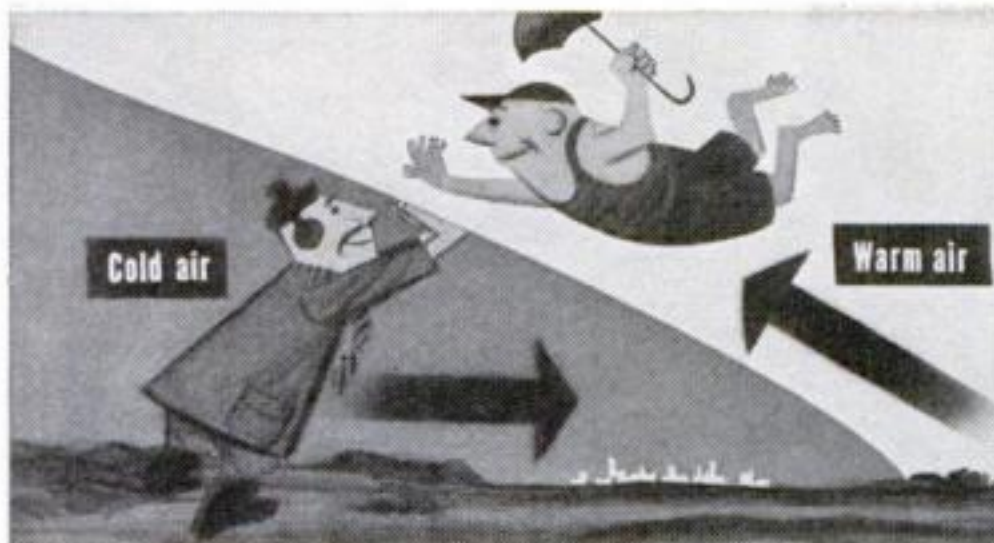


Unlike the hurricane, which ranges up to 500 miles, the tornado usually cuts a destructive swath only 300-400 yards wide. A few have extended over a mile.

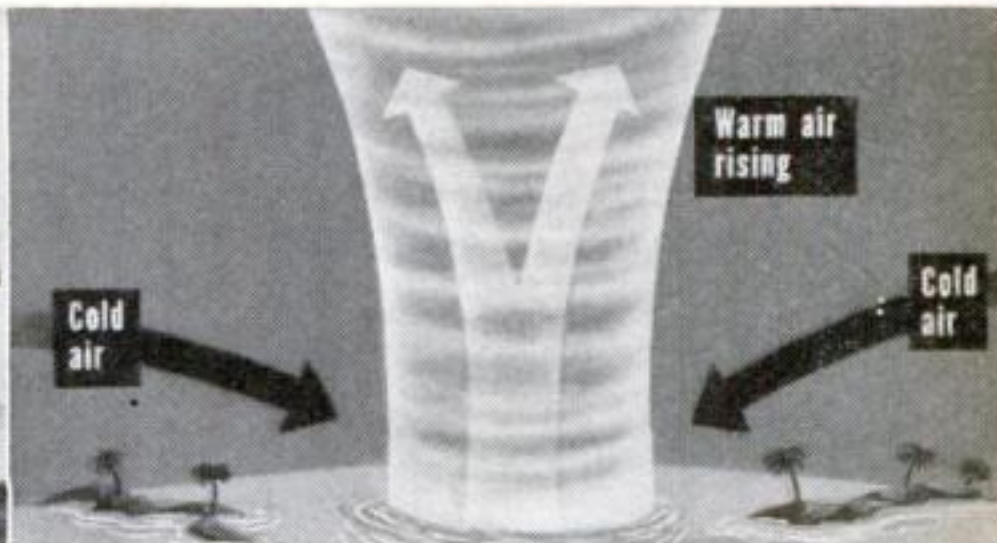
THE rhythmic rolling of the surf slows to a long swell. The air is hot and still and very damp. Dark, angry clouds spread across the sky. Suddenly the wind rips across the shore, drenching it with

rain and salt spray. A hurricane has hit. What causes these killer storms?

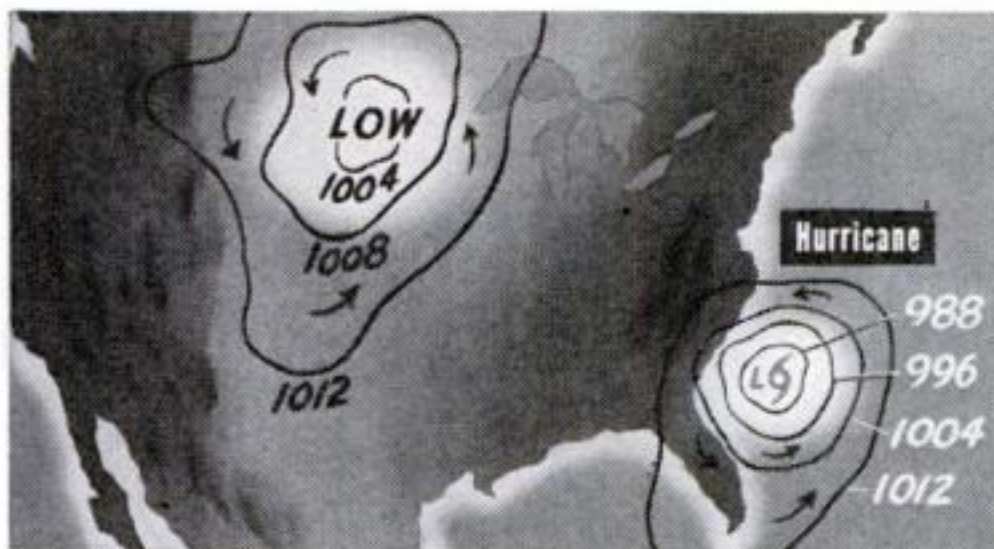
Weathermen still don't know all the answers. But the sketches below show basically what happens.



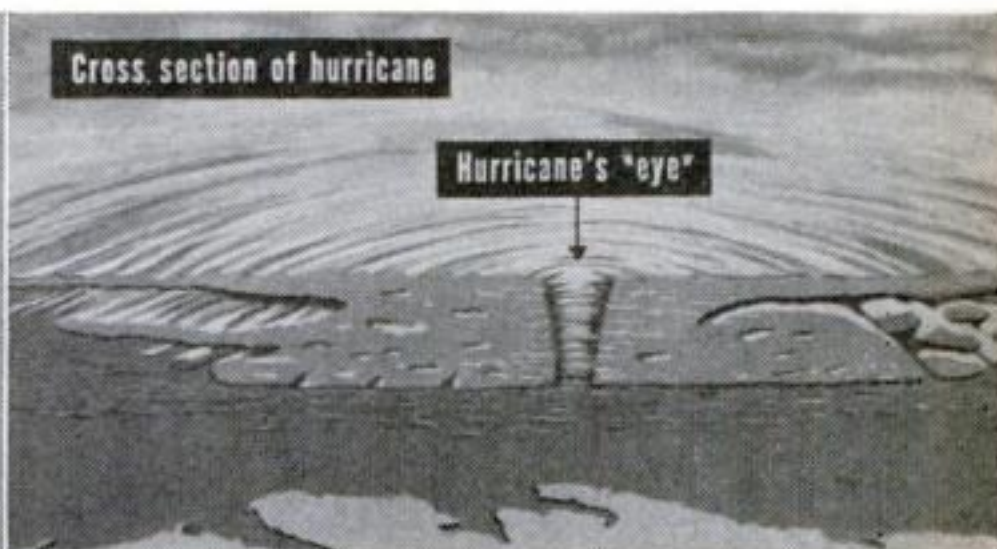
Cold, dry air pushes in underneath the warm, moist air. The earth's spinning makes cold air swirl around rising warm air, in a spiral effect.



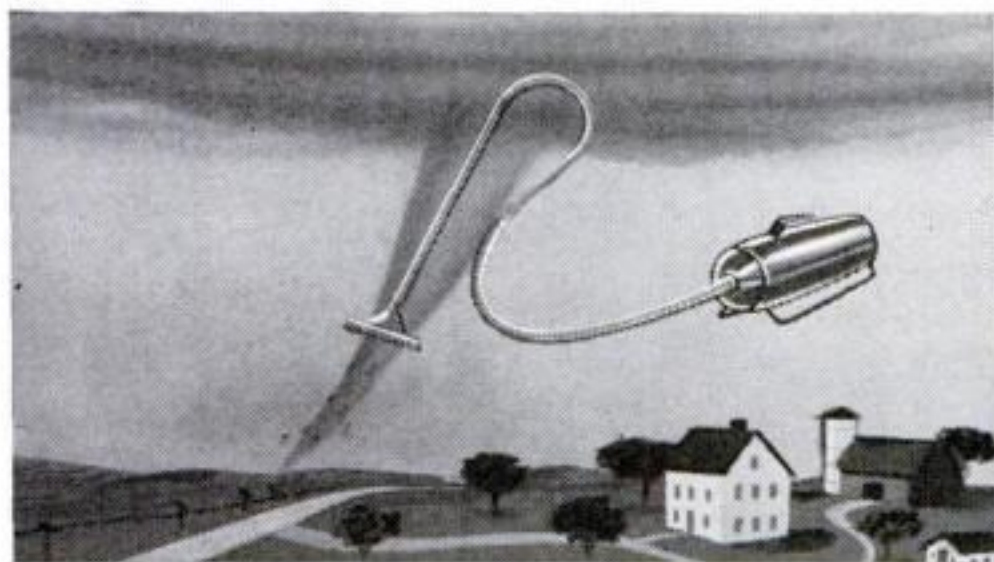
With the rise of warm air, a low-pressure area forms. Into this rushes cold air. With the ever-faster spiraling updraft, energy of hurricane proportions is stored up.



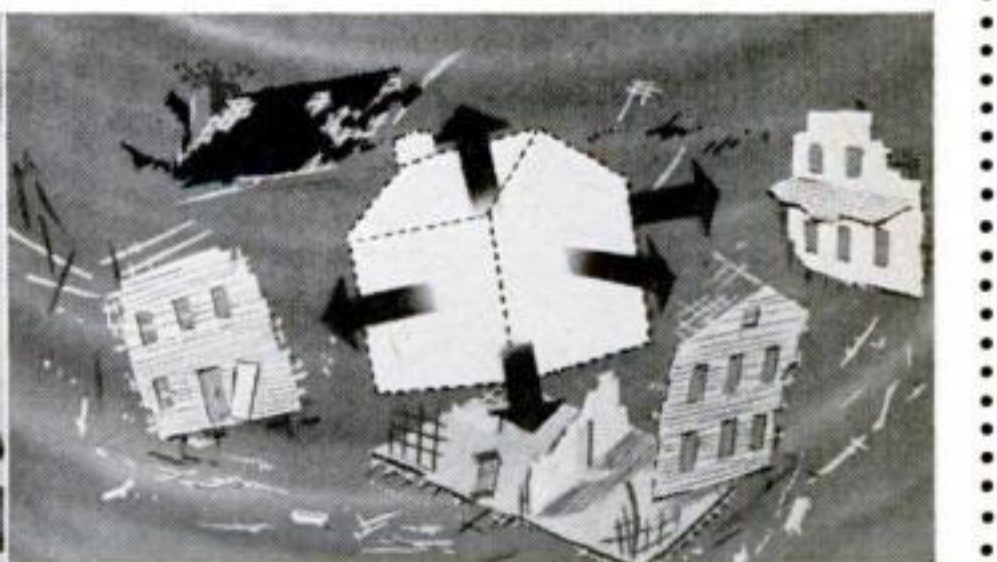
The lower the pressure, the greater the wind velocity. Planetary (high-altitude) winds will carry a storm thousands of miles.



Hurricane's eye, or center, is relatively calm, but surrounding winds may hit 200 m.p.h. As they near the eye, their speed increases. Updraft reaches up eight miles or more.



As warm and cold air meet, an updraft forms and creates effect of mammoth vacuum cleaner. Spiraling winds may reach up to 800 m.p.h.



Buildings often explode because the high air pressure inside them pushes out against the low pressure in the tornado's funnel. The high winds can drive a straw through a pole.

Homing radio spots downed pilots

Two directional radio antennas and a left-right meter enable rescue planes to home in immediately from as far as 150 miles away on a pilot downed on land or at sea. When both antennas are at right angles to the downed pilot, the meter registers zero, and the plane then flies on a straight line. When it's directly overhead, the needle dips.

The system, developed by Douglas Aircraft Co., includes a floating antenna for the "lost" pilot. Connected to a waterproof belt-radio transmitter, this antenna sends distress signals as soon as the pilot pulls his parachute rip cord. It's encased in a rubber bag that inflates automatically and floats upright.

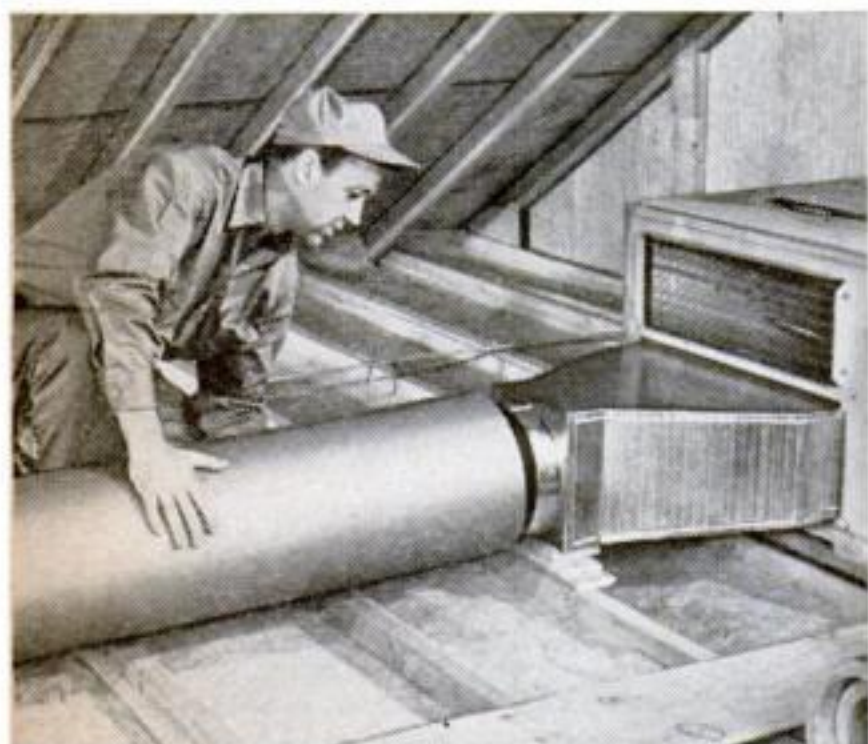


INDICATING METERS mounted on top of instrument panel enable rescue plane to home in on downed pilot. Needle at right registers zero when two left-right antennas put plane on course.



Smörgåsbord Row

A row of vending machines on a main thoroughfare in Stockholm, Sweden, lets working wives buy food for dinner while on the way home. It's 100 feet long; contains 1,515 compartments, 492 refrigerated; offers milk, fruit, vegetables, meat, bread, and a number of specialties.



Fiber-glass air ducts

Vinyl-coated fiber-glass ducts are made to carry either hot or cool air. Thermal-insulated and sound-absorbent, they have the same inside diameter as sheet furnace pipe and can be installed with standard fittings. Armaglas is made in six-foot lengths by Armstrong Cork.



Works on moonlight

A photodetector so sensitive that it responds to weak rays from the moon has been built by IBM for the National Aeronautics and Space Administration. It's part of a system that points an orbiting satellite's instruments in the right direction to help collect data in space.



RESCUE PLANE homes in on pilot and floating beacon antenna (arrow). From here it can circle overhead and call helicopter or boat to the scene to pick up the downed pilot.



ANTENNA is in rubber bag that inflates automatically and floats upright. It is connected to belt radio by waterproof cable. Radio begins broadcasting when pilot bails out.



Hand-pump respirator

A bellows attached to a face mask provides artificial respiration by forcing air into a victim's lungs. It's pumped by hand, has a valve that diverts exhaled air to keep it from being breathed again. A whistle warns if anything isn't working properly or air isn't entering the lungs. The resuscitator was invented by a London doctor.



"Flak" from static electricity

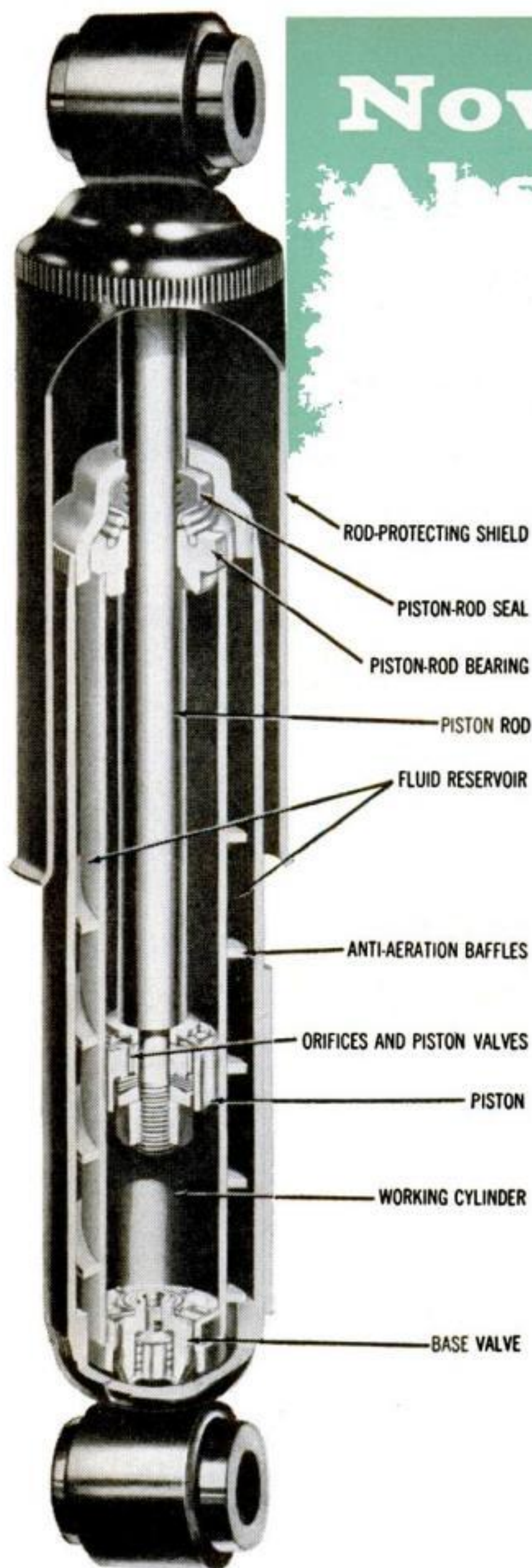
The unusual photo above was taken by a movie camera as an Air Force Globemaster approached an air-drop zone at the South Pole. The "stars" in the sky resulted from static electricity caused by rapid film movement inside the camera in the extremely cold, dry climate of the Antarctic.



Laundry travels on wheels

A trailer now takes laundromats to resorts and villages where operating a stationary establishment would be unprofitable. The LaundroMobile contains 20 coin-operated washing machines, six dryers, water, pumps, and its own generator for electricity. The vehicle is made by Automatic Service and Supply Co., San Antonio, Tex.

Now Shock Absorbers



MOST DIRECT-ACTING SHOCKS are arranged as shown in this cutaway of a Monroe-Matic. Piston is attached to car body, cylinder to axle. Fluid flows to and from reservoir surrounding the cylinder through a valve at the base.

Recent trends in suspension design are giving your shocks a bigger-than-ever job to do

By Hubert Lockett

IF YOU feel uneasy about controlling your car in a quick maneuver at high speed, or if the rear end tends to walk off the road taking a turn on a moderately rough surface, it may be that your shock absorbers are too weak to do their job. If making time on a rolling, winding blacktop is like crossing the wake of the Queen Mary in a rowboat (or you become momentarily airborne taking a grade crossing at a rapid clip), you can be sure it's time to do something about the shocks.

Don't discount this possibility just because your car is new or you have only a few thousand miles on your present shocks. Unless you've kept up with the changes that have been going on, you'll be surprised to learn how far you can go in tailoring your ride to suit your personal tastes and driving habits by changing shocks.

Talking to ride and suspension engineers, I found that the reasons behind this come from two directions:

- Modern suspensions assign a bigger role to the shocks—they rely on shock-absorber control as a trapeze artist relies on his partner.

- Shock absorbers have become far more sophisticated machines—more versatile, effective, and “intelligent.”

Softer and softer. Car makers have been trying to outdo one another in the



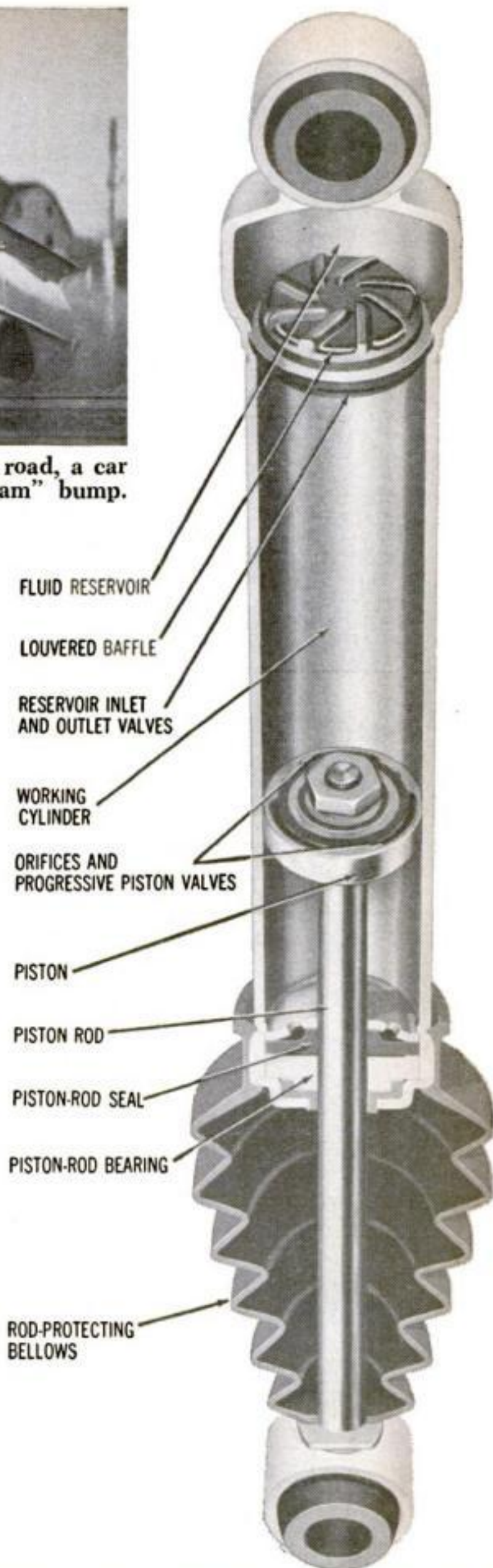
BOTTOMING VIOLENTLY, its front wheels leaving the road, a car with weak or worn shocks takes a "thank-you-ma'am" bump.

past few years to produce a luxurious "boulevard" ride for normal driving. To get the lower spring rates and ride frequencies needed for this, suspension designers keep making the springs more limber and finding ways to reduce suspension friction. They've gone to coils, torsion bars, and longer leaf springs. They're even experimenting now with single-leaf springs.

Softer springs are fine for soaking up small bumps—yielding so easily that little disturbance reaches the car body. But when the going gets a bit rougher, wheel deflection is apt to get out of hand. Not only do the wheels want to move too far—they don't want to stop bouncing. This is where the shocks come in. The only way you can get by with ultra-soft springs is by additional control from another source. If you want to preserve the smooth-road ride, the control should be added with some discrimination—very little on small bumps but plenty of muscle to take care of the big passenger-jarring ones.

As one engineer describes the problem: With the old stiff suspensions, shocks were expected simply to limit body motion on rebound after a hard bump—main consideration being control of the sprung masses. The stiff springs did a fair job of keeping wheel motion under control. Now the emphasis has shifted. The outstanding problem is control of the unsprung masses. The shocks have to cope with shake and jitter and keep the wheels out of the air and on the road.

Shock absorbers are heat machines. As spring rates and frequencies come



DIFFERENT ARRANGEMENT used by Columbus replacement shocks has cylinder attached to car and piston to the axle. Fluid reservoir is above the cylinder. Maker claims that less agitation and more direct flow minimize aeration.

Engineers are finding new jobs for shocks—as well as ways

down, shock absorbers have more work to do. At 50 m.p.h. on a washboardy blacktop, the shocks on your car will absorb about enough energy in a mile to lift a two-ton car 24 feet. Basically they do this by converting energy from suspension motion into heat and delivering the heat to the atmosphere. The heat is generated by fluid friction as oil in the shock is forced, through appropriate restriction, from one working chamber to the other. Its effectiveness in continuous use is limited by the amount of heat it can dispose of.

Since about 1956, direct-acting shocks have been almost universally used on passenger cars. Typically, the piston is attached by a rod directly to the sprung weight; the cylinder and reservoir are fixed to the unsprung mass. Usually, the valve action that controls fluid flow occurs in three phases, depending on the speed with which the piston moves up and down in the cylinder. These involve: low-speed orifice, blowoff valve, and high-speed restriction.

The low-speed orifice is little more than a slow leak, allowing a small flow at all times. This is the only mode of operation you can test by stroking a shock absorber by hand. Since it is effective at slow stroking speeds, it is the phase involved in the smooth-road ride. The choice of orifice size should provide enough control to prevent body "float" without introducing hard feel or low-speed harshness.

At higher road speeds on moderately rough surfaces, or on hard bumps, the low-speed orifice can't handle the additional fluid flow due to the increase in

stroking speed. Fluid pressure rises until it forces the blowoff valve open, allowing flow through a second, larger, orifice. Since this valve will usually open wider as flow increases, it tends to keep the amount of shock control fairly constant over a considerable range of piston speeds.

The third phase comes into play at still higher stroking speeds. The high-speed restriction is an orifice placed upstream of the blowoff valve so that fluid must flow through it before it reaches the valve. It limits flow at high stroking speeds, giving an increasing amount of shock control as speed increases. It has practically no effect at low speeds but can prevent bottoming when you hit such bumps as a "thank-you-ma'am" railroad crossing.

The variations. There are exceptions to this three-phase operation. Chrysler has used shocks in which the flow is entirely controlled by open orifices. Characteristically, these give very light control at low stroking speeds, but more than twice as much at double the speed. Columbus replacement shocks use a different kind of valving. Instead of a blowoff valve that opens at a set pressure, an arrangement varies the opening of the fluid passages continuously.

In any case, the amount of control exercised for both jounce and rebound can be varied by choice of valving and orifice sizes. There is no "right" answer. What finally winds up on your car is largely a seat-of-the-pants judgment by a ride engineer as to the kind of ride you want. While shocks bring a degree of "intelligence" to the job of controlling



WALLOWING and heeling during quick maneuvers at high speed can be helped by shocks giving firmer control. Don't expect to make your sedan corner like a sports car—other suspension elements control lean in a long hard turn—but shocks do resist the effects of sudden side forces.

to do old jobs better

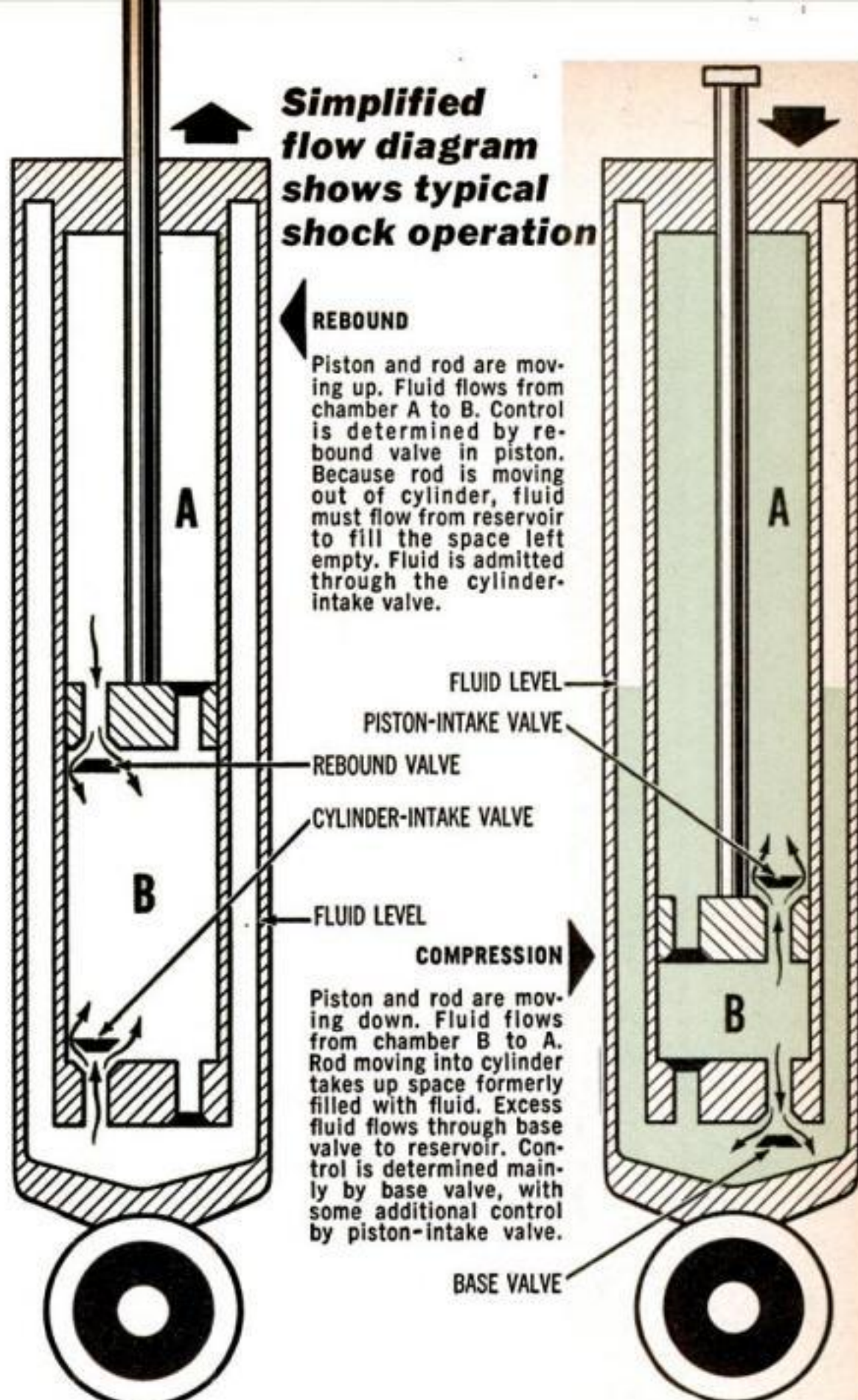
wheel deflection, their I.Q. is still not high enough to avoid some compromise between a soft ride and a controlled ride at high speed.

A story told to me by three different engineers illustrates the point. Details varied in each telling, but the sense of the story was this: A bright young engineer who had made something of a reputation as a ride man was enticed away from his original employer by a rival manufacturer. He was given the job of working out final details on the ride for one of the next year's models. After weeks of painstaking labor, he was sure he had it made. The company brass went for a ride.

"This is great," they commented as they put the car through its paces. "Finest ride we've turned out yet. Handles beautifully. But our customers expect a plusher ride. Let's take out about half the shock control."

The double standard. The philosophy of ride engineers working for shock-absorber manufacturers leans toward firmer control than is usually chosen by the car makers. According to one shock manufacturer, his standard replacement shock gives about 10 percent more control than the original equipment it replaces. His heavy-duty replacement gives about 25 percent more, and his extra-heavy-duty gives about 40 percent more. The heavier-duty types are larger in diameter, and so the internal working pressures are lower for a given amount of control. This not only promises longer life, but some experts say the lower working pressure allows firmer control with less harshness. You don't have to settle for a fixed control characteristic—Gabriel sells an adjustable shock that allows you to choose rebound control in three steps.

One problem shock-absorber designers

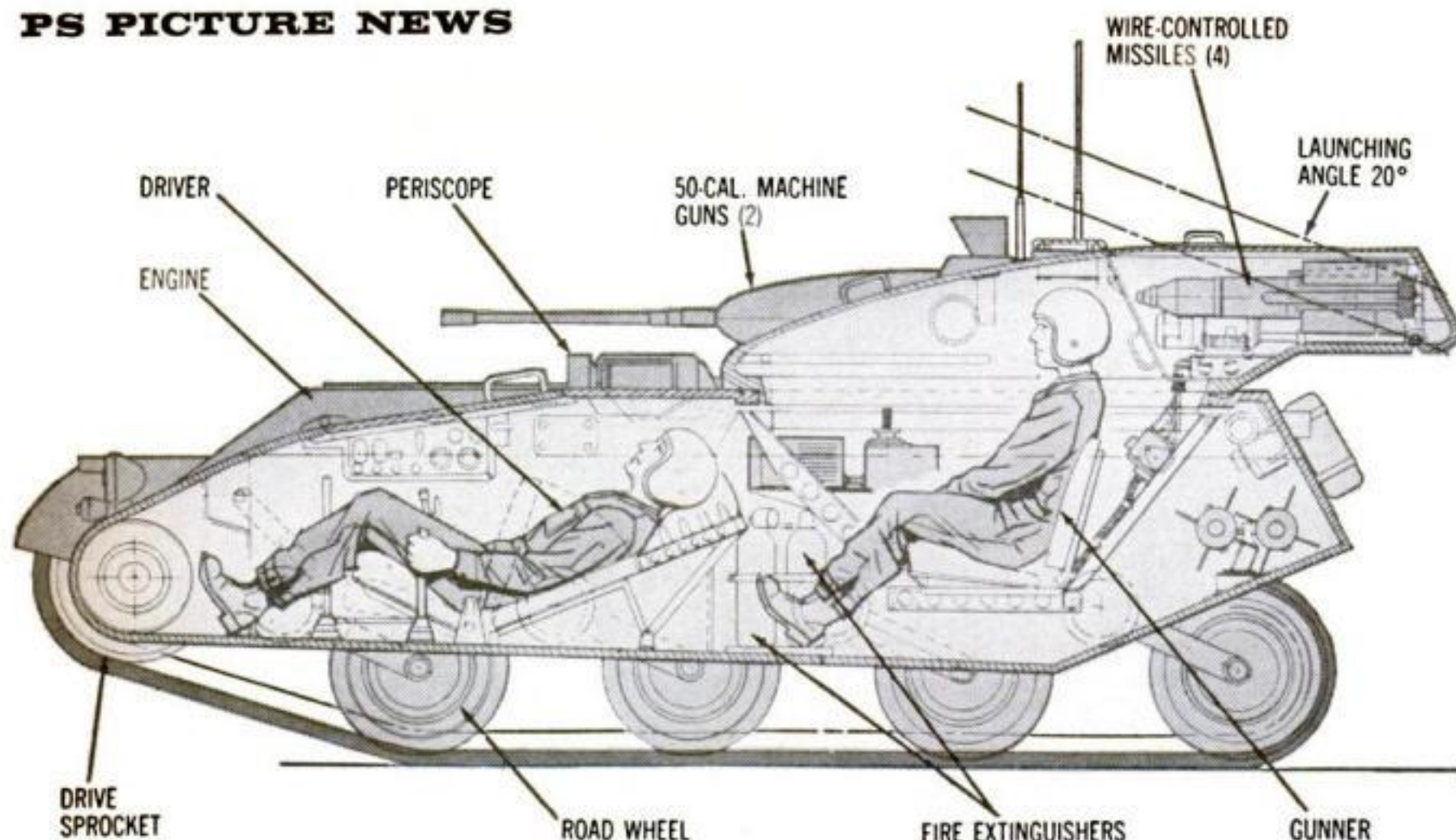


must cope with is air becoming trapped in the fluid and forming a compressible mixture. In mild cases this may only cause a jerk in the ride. Under severe operating conditions it can cause substantial loss of control.

Here's how it happens: The piston works up and down in a cylinder filled with fluid. When the piston moves into the cylinder, the added length of piston rod takes up space. It's like fingering an olive from a full Martini—it overflows.

In a shock, there must be a reservoir to take the overflow and allow the fluid to return to the cylinder when the rod is withdrawn on the return stroke. An air space is needed in the reservoir to take care of fluid expansion. With the standard design, the reservoir is a ring-

[Continued on page 179]



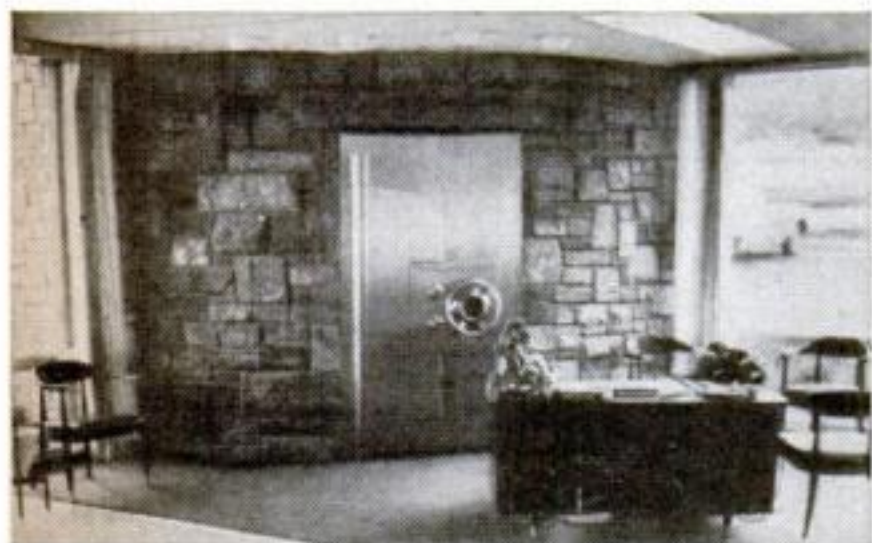
Compact tank would fire missiles

This aluminum tank has been proposed to the Army. It could be used for both reconnaissance and assault, and would fire wire-guided missiles. Forsyth & Co., Burbank, Calif., plans an engine and

other parts similar to those in compact cars. With driver supine, the low silhouette would be a poor target for enemy guns. The tank would weigh five tons, could be airlifted by helicopter.



Outside stone vault is striking architecturally.



Only door to vault is behind manager's desk.

Circular bank vault

The vault of this branch bank at Dumfries, Va., is three-quarters outside the building. The stone "roundhouse," 20 feet in diameter, is at one corner, but you can get in it only from inside—through a 3½-inch-thick steel door.



Gnat merry-go-round

The inverted funnels around the rim of the table above are gnat traps. They are baited with the same kind of substance that attracts the insects to your eyes on sultry days, and the table is rotated by motor so that each trap collects approximately the same number. Then University of California scientists add repellents. They are trying to determine which best cancels the attractive power of the bait.

POPULAR SCIENCE BOOK DIGEST

Adventures of the U.S. Secret Service



***Exciting tales from the files of one of the
world's foremost crime-fighting agencies***

Condensed from *The United States Secret Service* by Walter S. Bowen and Harry Edward Neal (Chilton Books, Philadelphia and New York, \$4.95). Copyright 1960 by the authors.

Robbing the Money Factories

By Walter S. Bowen and Harry Edward Neal

The fabulous treasures of silver coin, gold ingots, and newly printed money that lie in the vaults of the U.S. Mints at San Francisco, Denver, and Philadelphia, and in the Bureau of Engraving and Printing in Washington, have probably tempted many thieves; yet few have tried to lay crooked fingers on this wealth of the nation. And the few who have tried have not completely succeeded, thanks partly to security safeguards and partly to the efficiency of Secret Service agents.

.....

The Mystery of the Missing Gold Bricks

IN 1889, Secret Service Agent (later Chief) A. L. Drummond was aboard a train on a vacation, heading from Washington to Maine. At the railroad station in New York he received a telegram from Chief John S. Bell in Washington. The message was cryptic: GO SEE DIRECTOR PRESTON, PHILADELPHIA MINT, AT ONCE. HIGHLY IMPORTANT.

Drummond had a flair for solving mysterious cases. They were a challenge, a means of pitting the shrewd against the clever, the hunter against the prey. Perhaps something had happened at the Mint that would make up for the interruption to his vacation.

He was not disappointed. At the Mint he sat with Director Preston and Superintendent Bosbyshell in Preston's office.

"We're missing about 130 thousand dollars in gold," Preston said. "I don't have to tell you that we're pretty upset."

"Do you have any leads?" Drummond asked. "Any ideas who might have taken it?"

"None. That's 700 pounds of gold, and there's not a single clue. The vault doors haven't been tampered with. The combination of the inside grilled door is intact. Everything is just as it should be, except that 50 gold bars have disappeared!"

"When did you discover the loss?"

"Yesterday. Superintendent Bosbyshell was with me when we went into Vault Six and learned of the shortage. To make sure there was no mistake, we weighed the contents of the vault, and we were shy 50 bars."

Drummond nodded thoughtfully. "How many men know the combination of the vault?"

"Only three. Bosbyshell, Cochran, who is our official weigher, and I.

But even if Cochran or I could have opened the main vault door, there was still the inner iron-grille door. That's always sealed and locked, and the combination is known to only two other men—Jamieson and Strubel. Whenever gold bars are to be put in or taken out, one man of each team must be on hand—one to open the main door, one to open the inner grille."

"It sounds pretty thiefproof," Drummond commented. "But what's the possibility of collusion between Cochran, for example, and either of the two who hold the combination to the grille?"

"Oh, come now, Mr. Drummond," Preston said. "All these men are above suspicion, and . . ."

DRUMMOND interrupted. "But they're the only ones who could open the doors . . . and 50 gold bars *have* been removed." He paused a moment. "You mentioned that the inside grilled door was sealed and locked. Was the seal intact when you discovered the loss?"

"That's another thing," Preston answered. "The grilled door was locked and properly sealed with the official stamp—and the stamp is put on only in the presence of both men who know the combination. If there was any inside conspiracy, it would have to include at least three people—Jamieson and Strubel, plus Cochran, Bosbyshell, or myself. But I must remind you, Mr. Drummond, that we're talking about 700 pounds of gold. That's a load that a man can't simply put under his shirt and carry out. Besides, there's a guard at every door. Nobody is allowed to take out any package unless the guard passes it."

"Thank you, Mr. Preston," Drummond said. "Now let's not spread the news that I'm here to investigate this shortage. I want to scout around awhile."

"Of course. We'll do whatever we can to help. Do you have any ideas?"

Drummond shook his head. "Not yet. But nine times out of ten the crook who tries hard to hide every possible clue will overlook some little thing." He stood up. "May I have a look at the vault?"

"Sure thing. But I should tell you that we took the grilled door off its hinges to carry out the vault contents for audit. That's how we discovered the shortage. The door hasn't been replaced yet."

In the basement, Drummond was introduced to Cochran, the weigher, as "a visitor who'd like to see our vaults."

As they approached Vault Six, Drummond said, "I wonder if I might have a look inside this one?"

"You certainly may," Preston said. "Go ahead, Cochran—open it."

Cochran twirled the dial, right, left, right and left, then stopped and pulled on the handle to open the door. It didn't budge. Again he worked the combination. Still it failed to open. "It doesn't seem to work," Cochran said.



*Cochran pulled on the handle.
The heavy door didn't budge.*

BOOK DIGEST : U. S. Secret Service

"Let me try," Superintendent Bosbyshell said. Under his manipulation the heavy door swung back smoothly.

Inside, Drummond looked closely at the bars of the grilled door from top to floor, then asked that the door be replaced on its hinges. Cochran set it up level with the floor, merely holding it in place. "Is that the way it always hangs?" Drummond asked.

"No, sir," Cochran said. "But it's very heavy and I thought you just wanted a general idea how it looked."

"I'd like to see it on the hinges, if you don't mind. Here—I'll give you a hand," he said, taking off his coat. "Better take off your coat, too," he added, smiling. "This is going to take some muscle."

COCHRAN glanced inquiringly at the superintendent, who nodded. Cochran removed his coat and helped Drummond place the door on its hinges. Drummond stood slightly behind Cochran, his eyes on the man's back and waist.



Drummond stood slightly behind Cochran, his eyes on the man's back.

"Thanks very much," Drummond said.

Cochran left the vault, and Director Preston scratched his head. "What was that all about?" he asked.

Drummond pointed to the bottom of the grilled door. "Did you notice those scratches on the grille, about four feet from the floor?"

Preston shook his head. "What about them? That door has been there a long time. Probably all the doors in the other vaults have the same scratches."

"I hope not," Drummond said, "because if they do, you've probably had shortages there, too."

The Director chuckled. "You're way off, Mr. Drummond. We've weighed the gold in all the other vaults and it's intact. This was the only shortage."

"Fine! Then we won't have to worry about the others. Now, may I use the telephone in your office?"

On the way upstairs, Preston wanted to know more about Drummond's suspicions. "Let's wait until I prove things out," the agent said. He telephoned the Philadelphia office of the Secret Service and asked that three agents be assigned to him immediately. In a little while, the agents met Drummond at the Mint and he left with them.

Drummond and the agents returned about two-thirty. "Ask Cochran to come up," he said. "And bring in Mr. Bosbyshell, too."

WHEN they arrived, Drummond wasted no time. "Cochran," he said sternly, "I want to know what you did with the 50 gold bars you took from Vault Six."

"What are you talking about?" Cochran asked, his face flushed. "Are you trying to say—"

"I'm saying you stole that gold," Drummond said. "The sooner you return it, the more leniency you can expect."

"Mr. Preston!" Cochran exclaimed. "This is ridiculous! I—why, you know that I couldn't possibly carry 700 pounds of gold out of the building, even if I had the chance."

"You had the chance, all right," Drummond put in, "and I know how you got the gold out. You took a piece of bent wire and dislodged the bars from the top of the pile next to the door, then slipped each bar underneath the door. You didn't have to go inside the grille at all. And I know how you smuggled the bars out of the building." He pointed to the three men. "These are Secret Service agents," he said. "This afternoon it took the four of us less than an hour to find the tailor who made the secret pocket in your pants—and this morning I needed only one look to see that your suspenders were especially strong. You wore a long coat to cover any suspicious bulge in your false pocket. No guard would stop you at the door unless you were carrying a package he could see. You took the bars out one at a time—and you might still be stealing them if the shortage hadn't been noticed yesterday."

COCHRAN stood silently, staring at the faces of the men in the room. Suddenly he lowered his head and began to sob. No other confession was necessary. Later he led Drummond to an unused sewer pipe leading from the basement of his home, where the gold was hidden.

"I still don't understand how you figured it out," Preston told Drummond.

"Just common sense," the agent said. "The scratches were a clear indication of the way the bars had been taken out. I suspected Cochran when he seemed unable to open the vault door—a guilty conscience made him nervous. When he didn't want to put the door on the hinges, I figured there was a reason—he didn't want me to see that there was space enough underneath to pull a gold bar through. I saw that he had those peculiar suspenders and that his trousers were unusually wide at the waistband. The bars had to be smuggled out under someone's clothing. I put all the facts together and—luckily—came up with the right answer."

Drummond shook hands with Preston and sent a telegram to Chief Bell: MINT CASE SOLVED. REPORT FOLLOWS. GOING ON VACATION.

.....

The Man Who Walked Off with a Bundle of Bills

PERHAPS the most sensational theft from the nation's money factories occurred in December, 1953, when James Landis, 29, an employee of the Bureau of Engraving and Printing in Washington, carried \$128,000 in newly printed \$20 bills out of the building, and concealed another \$32,000 in the Bureau itself to be taken out on another trip.

Landis' job at the Bureau was to operate a currency-wrapping machine.

BOOK DIGEST : U. S. Secret Service

The new \$20 Federal Reserve notes, in bundles of 4,000 bills, held together tightly by flexible steel hands, were sent to his section to be neatly machine-wrapped in heavy brown paper. To each bundle, or "brick," was affixed a label describing the contents, including the serial numbers of the bills. Once wrapped and labeled, the bricks were piled on skids, or wooden platforms, to be carted into the vaults and stored.

Landis plotted long and carefully for his bold theft. During the weeks before the robbery he removed metal bands, paper straps, and small boards (used for stiffening the packages) from waste material at the Bureau and concealed them under his clothing, taking them home.

There he cut a large quantity of plain bond paper into pieces the size of genuine bills, using the blank paper and stolen waste to make up two dummy packages exactly like those in which the \$20 bills were wrapped at the Bureau. The plan was simple. He would substitute the dummies for two real packages of \$20 notes, worth \$160,000. The dummy packages would be stored in the vault, perhaps for weeks. When they were finally discovered it would be virtually impossible to identify the thief among the many people who would have had access to the contents.

On Dec. 30, 1953, at six o'clock in the morning, Landis telephoned a friend, Charles H. Nelson, asking him to buy a metal box. He also asked Nelson to invite another friend, Roger C. Patterson, to Nelson's home that night, where Landis would meet them both.

Landis wrapped the two fake bundles together and took the package to the Bureau when he reported for work that morning. In his pockets were two ordinary paper bags. Under Bureau regulations, employees were not per-



He cut the plain bond paper into pieces the size of genuine bills.

mitted to carry packages to their work areas and were required to check all parcels in a room provided for that purpose.

Landis carried the wrapped package past the guard at the door and deliberately headed for the parcel booth, ostensibly to check his package. The guard watched him as he approached the checking booth, but turned away to keep an eye on other employees arriving for work. Quickly Landis hurried away from

the parcel room, carrying his package to the third floor, where he concealed it under a burlap sack suspended within a large trash can in Locker Room No. 327. He then went to his own locker room, D-101, on the first floor, changed into his work clothes, and reported for duty at his regular 7:30.

TWENTY minutes later, he lifted two wrapped bricks, each containing \$80,000 in new \$20 bills, from a skid parked several feet from the entrance to Vault D-19. He took the bricks to his wrapping machine and bundled them in a sheet of kraft paper, then carried this package to the

fifth floor of "A" Wing, which was a section of the Bureau used for dead storage.

There he unwrapped the package, removed the labels bearing the package number and serial numbers and put the labels in his pocket. Next he cut the steel bands from the bricks and placed the packages of \$20 bills in the two paper bags he had brought from home. He put \$128,000 in one bag and \$32,000 in the other, and hid both bags under a pile of material in the dead-storage area. He then returned to his post at the currency-wrapping machine on the first floor and continued working there until 10:50 a.m., when he was given a customary 20-minute coffee break.



He soaked the labels off and dried them on the hot radiator.

Landis went to Locker Room 327, soaked the labels off the brown paper with hot water, and dried them on the hot radiator. He took the labels to the trash can where the dummy bricks were concealed, removed the fake packages, and took them into a toilet stall. There he pasted the genuine labels on the ends of the dummy bricks, using glue he had brought from the wrapping room. With a rubber stamp, purchased especially for the theft, he stamped the labels "HA 12-31-53," to indicate that a Bureau employee with the initials "HA" had machine-wrapped these packages on Dec. 31, 1953.

After covering the two dummy bricks with heavy brown paper, Landis carried them to the first floor and placed them on the storage skid among other packages containing \$20 bills, wrapped exactly as the dummies were.

At 3:10 p.m. Landis finished work, changed clothes in his locker room, and went to the dead-storage area on the fifth floor where his fortune was hidden. He stuffed a pair of dirty trousers, taken from his locker, on top of the \$128,000 in one paper bag, leaving the other bag with \$32,000 under the storage material. Now, with the bag holding the cash and the pants, he went to the first floor prepared to walk out of the building.

AT THE door the guard pointed to the bag. Calmly, yet breathlessly, Landis opened the bag, pulled the dirty trousers part way out, and grinned at the guard, who motioned him to proceed. Thus Landis walked out of the Bureau of Engraving and Printing with \$128,000 in new \$20 bills in a wrinkled brown paper bag.

He went directly to the home of his friend, Charles Nelson, where Nelson and Patterson awaited him as planned. In the bedroom Nelson showed him the green metal box he had bought at Landis' request. Landis took the trousers out of his paper bag, turned the bag upside down over the bed, and laughed as his friends stood goggle-eyed at the cascade of money that tumbled out.

"Where'd you get that money?" Nelson asked in awe.

Patterson asked, grabbing a package of the notes. "Is it real? Is it good?"

"It's plenty good," Landis answered. "Brand new. Just made."

BOOK DIGEST : U. S. Secret Service

"How'd you do it?" Nelson asked.

"Never you mind," Landis said. "Now you guys gotta help me. We have to change this for other money. Buy stuff in stores and get change." Landis divided 200 of the notes among the trio and told his companions to buy inexpensive merchandise, bringing the change back to Nelson's home, where it would be put in the metal box as a collective pot.

This was one of the most welcome tasks that Nelson and Patterson had ever performed. Nelson's first purchase was a half-pint of whisky. Then he embarked on a huge spending spree, buying more liquor, toilet goods, candy, neckties, shirts, playing cards, poker chips, and other articles.

The next day Landis met another friend, William Giles. In Nelson's Packard they drove to Brentwood, a Washington suburb, and Landis sent Giles into various liquor stores to buy whiskey with \$20 bills.

On Jan. 2, Landis and his mother bought a 1953 Oldsmobile sedan costing \$3,200. Landis made a down payment of \$1,224.46, including about 100 one-dollar bills and a number of \$5, \$10, and \$20 bills. Throughout Jan. 2 and 3, Landis and his companions continued to spend the \$20 notes.

On Jan. 4, Landis reported for work at the Bureau at his regular time. Another employee, Sewell A. Davis, a stockman, was assigned to transfer bricks of currency from a skid in Vault D-19 to another location.

Davis' method was to pick up one package in each hand simultaneously. As he grabbed two of the bricks he paused for a moment and then "hefted" them carefully. He glanced at a co-worker, Paul Coakley. "One of these

bricks feels light," Davis said. "Does it feel light to you?"

Coakley held the bricks. "Yes, it does," he agreed.



Davis paused a moment, then hefted the two bricks carefully.

DAVIS tore open the kraft-paper wrapping and was startled to see only blank white paper. Coakley delivered the fake brick to the supervisor of the section and returned to the vault, where another worker, Frederick A.

Minor, had just discovered Landis' second dummy. The Secret Service was promptly called in. Agents began to question employees who would have had access to the money bricks. At quitting time, the investigators had not yet reached James Landis, and he left with others at the customary hour, meeting Giles, who was to drive him home.

Before they reached Landis' home they heard a news flash on the radio announcing the theft of \$160,000 from the Bureau of Engraving and Printing.

At the Landis apartment they put the remainder of the \$20 bills and the other money in a large wooden box, and Landis, Giles, and Landis' wife, Mamie, put the box in the car and drove across the Potomac to Virginia.

"We're going to see my wife's father," Landis said. "He'll hide the money."

They stopped at a hardware store and bought a strongbox and padlock. At about 9:30 p.m. they arrived at the home of Landis' father-in-law, William I. Grant, who was employed on a private estate near Middleburg.

Landis told Grant about the theft of the \$20 bills.

"You shouldn't have done that," Grant said. "You know it wasn't right. You might know they'd catch up with you. You were foolish, plain foolish."

"I ain't so foolish, Pop," Landis said. "I got the money, ain't I?"

"Where is it?"

"Out in the car. And we're gonna leave it with you. You're gonna hide it for us."

"Oh, no. You don't mix me up in this. Not me!"

"Not for three thousand bucks?"

Grant looked surprised. "Three thousand bucks?"

"That's what you get for hidin' the dough," Landis grinned. "Okay, Pop?"

While Grant hesitated thoughtfully, Landis and Giles brought in the box with the money, and the new strongbox. Landis counted out \$3,000 in \$5 and \$10 bills, which he gave to Grant. Then the money was placed in the strongbox.

"You hide it some place," Landis said.



At Landis' apartment, they put the money in a large wooden box.

WILLIAM GRANT must have spent a sleepless night thinking about his daughter and her wayward husband. He finally sought counsel from his brother-in-law and also from his family physician. Early the next morning he telephoned an acquaintance, Trooper S. S. Secrist of the Virginia State Police, asking Secrist to come to his home.

Trooper Secrist learned the whole story from Grant, who turned over the empty wooden box and the strongbox filled with \$88,100 in new \$20 bills and \$4,671.13 in other money.

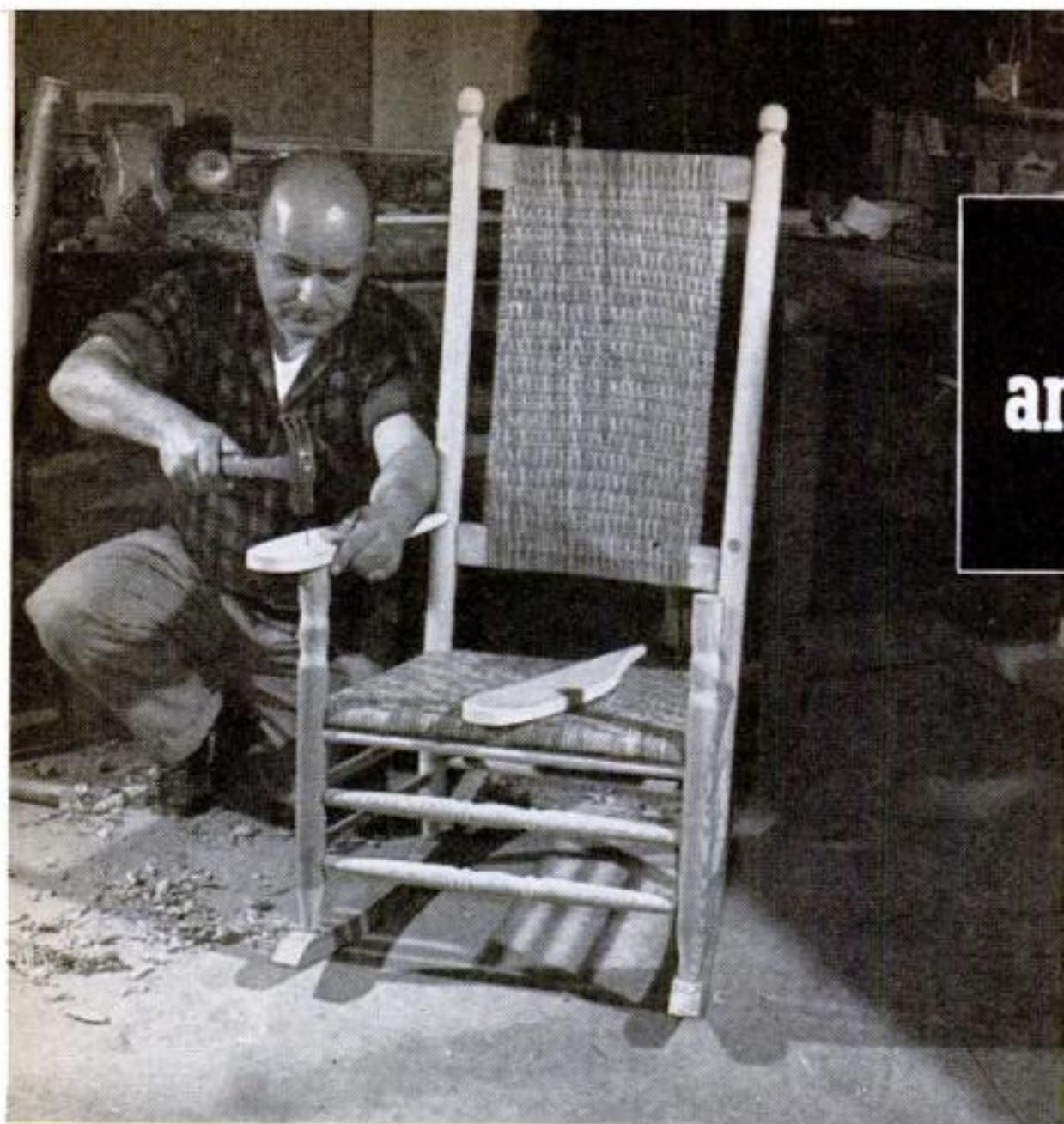
Secrist took Grant to the Centreville State Police substation and telephoned the Secret Service. Inspector Russell Daniel and Special Agent James M. Beary sped to the substation, received the boxes, and listened to Grant tell his story.

Rushing back to Washington, the agents promptly arrested Landis at the Bureau of Engraving and Printing. Confronted with the evidence, Landis admitted the theft and led the agents to the place where he had secreted the \$32,000 which he had intended to remove from the Bureau at a later date.

In rapid succession other agents arrested Giles, Patterson, and Nelson.

On May 3, 1954, all defendants pleaded guilty in Federal Court. They went to jail.

Next Month: More Adventures of the U.S. Secret Service



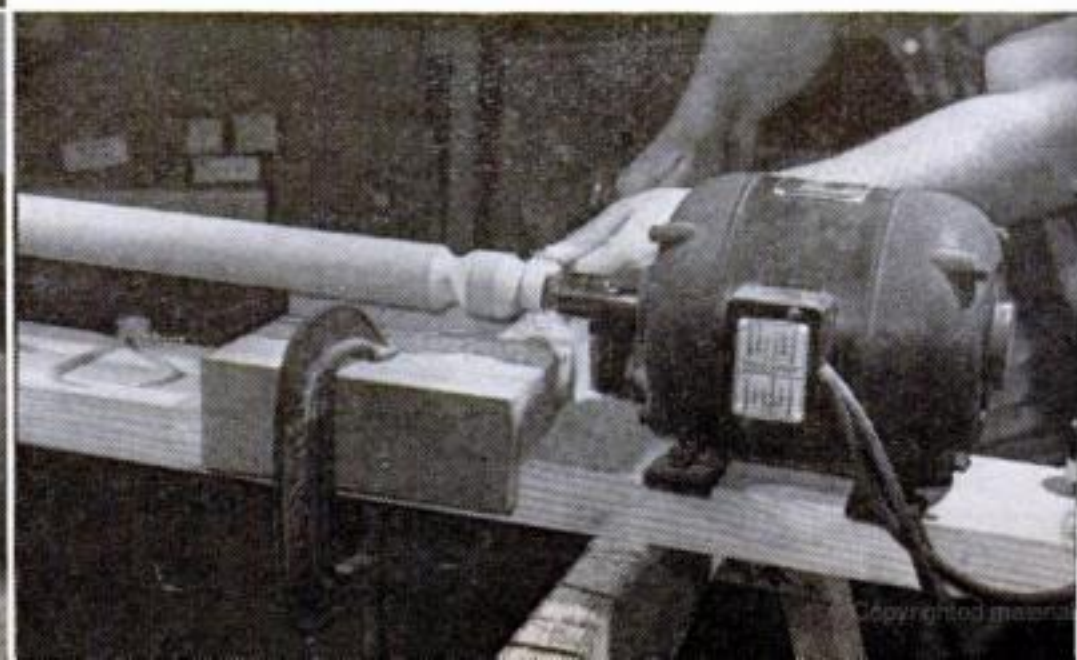
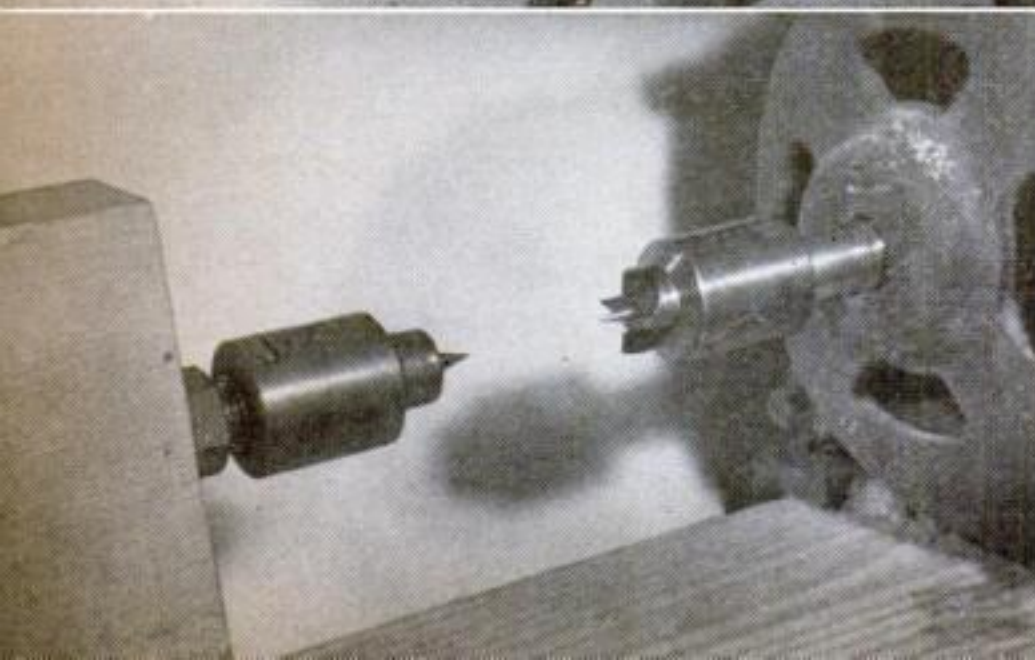
Mechanics and Handicraft SECTION

HOW YOU CAN BUILD A COPY OF THE ROCKER

A shop motor, bolted to a two-by-six, makes a lathe



TAILSTOCK AND TOOL REST are short pieces of two-by-six. Cleats nailed to their edges straddle the two-by-six bed (photo at left). A short length of threaded rod cuts its own thread when twisted through an undersize hole bored in the wood block on the tailstock. An old pulley serves as a handwheel for tightening the tailstock rod against the work. Special spur and cup centers in photo at lower left rotate and support the work. They're \$1.35 each in hardware stores, or from the Millers Falls Co., Greenfield, Mass. Use spur No. 917 on motors with a $\frac{1}{2}$ " shaft, No. 918 for $\frac{5}{8}$ " shaft. Cup No. 915 fits $\frac{1}{2}$ " rod. Ball-shaped finial can be turned by eye (below). Stubs at ends of turnings are cut off after they're removed from lathe, and top of ball is smoothed by hand. Allow extra 1" on stock for stubs.



Making Your Own Kennedy Rocker



By Herbert R. Pfister
PS PHOTOS BY W. W. MORRIS

YOU, too, can enjoy relaxing in a rocker exactly like the now-famous one in the White House. You'll also enjoy building it yourself.

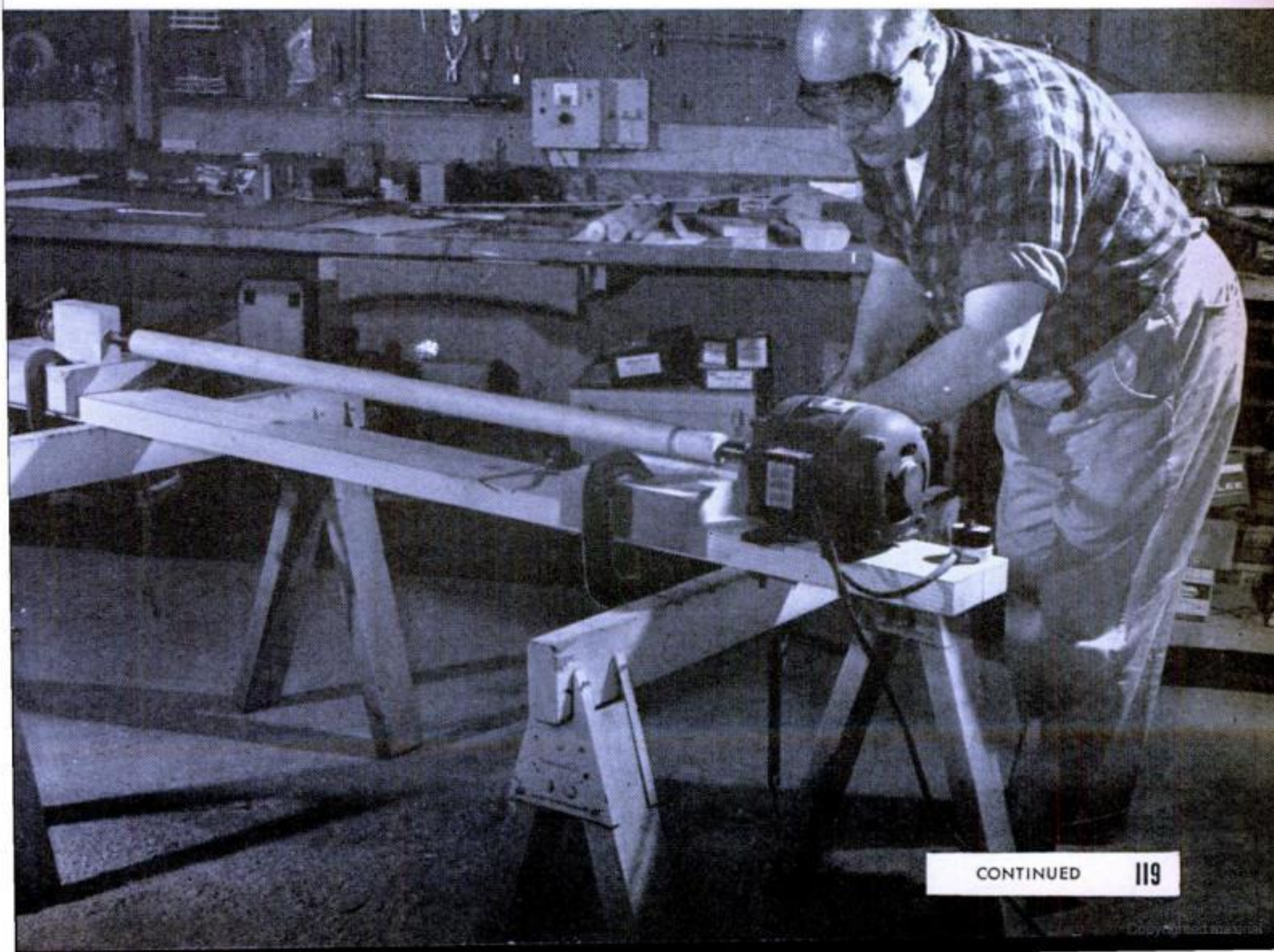
The manufacturer of the original chair,

W. C. Page, has given POPULAR SCIENCE permission to copy it to the last detail.

"Some fellows will try to build the chair anyway," Page said, "so they might as well do it from dimensioned plans."

You don't need a shopful of power tools to build a Kennedy rocker. Some of the parts look tough to make at home

long enough to turn the 44" posts for the chair back



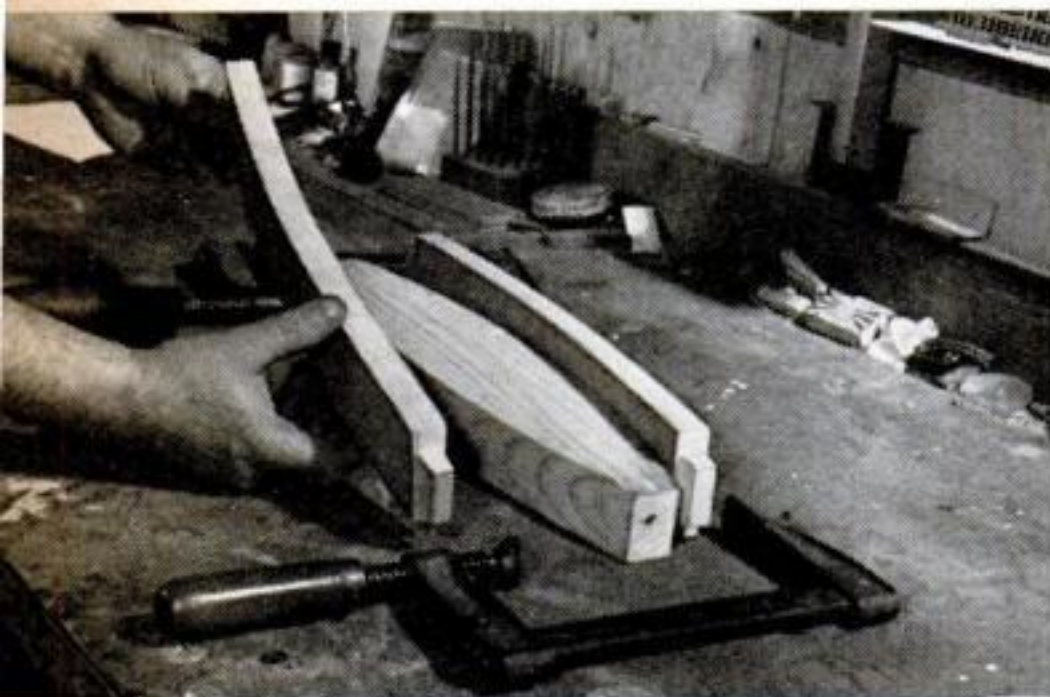


BEND IN BACK POSTS is secret of comfort in the original rocker. Soak posts with hot water for half an hour to soften them. Place bottom ends in the jig and draw top ends together with clamps. Let dry in jig for 24 hours.

but actually aren't. You get off to a good start at the lumber yard by buying $1\frac{5}{8}$ " round pine handrail or closet pole for the front and rear posts, and $\frac{3}{4}$ " hardwood dowels for the rungs.

The finials and tapered ends of the posts look like posers—lathe jobs and ones calling for an uncommonly big lathe at that. The trick here is to turn them on an improvised lathe cobbled together especially for this job. The back, armrests, and runners look as though they called for a bandsaw. Actually, they can be shaped by hand with such basic tools as a rasp, spoke shave, chisel, and coping saw. And the four parts that need to be bent clamp readily around forms.

Caning the chair is easy, too. Next month, you'll learn where to buy the cane and how to weave it.



CURVED STRETCHERS FOR BACKRESTS are bent in form similar to post-bending jig. Here they are removed from form after clamps have been released. Stretchers are cut to size and tenons formed on ends *before* soaking and bending.

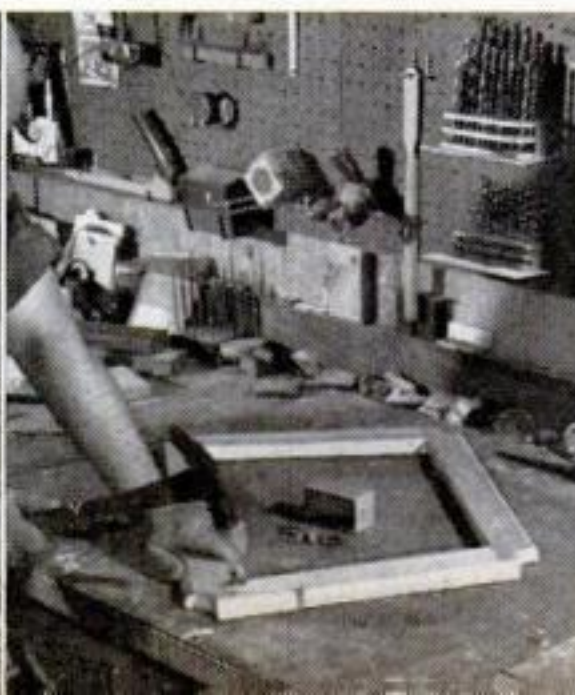
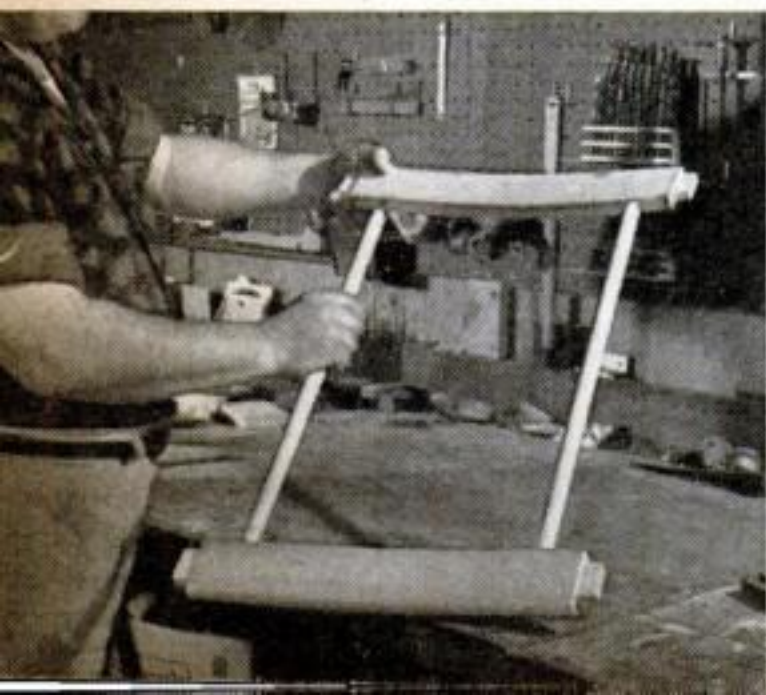


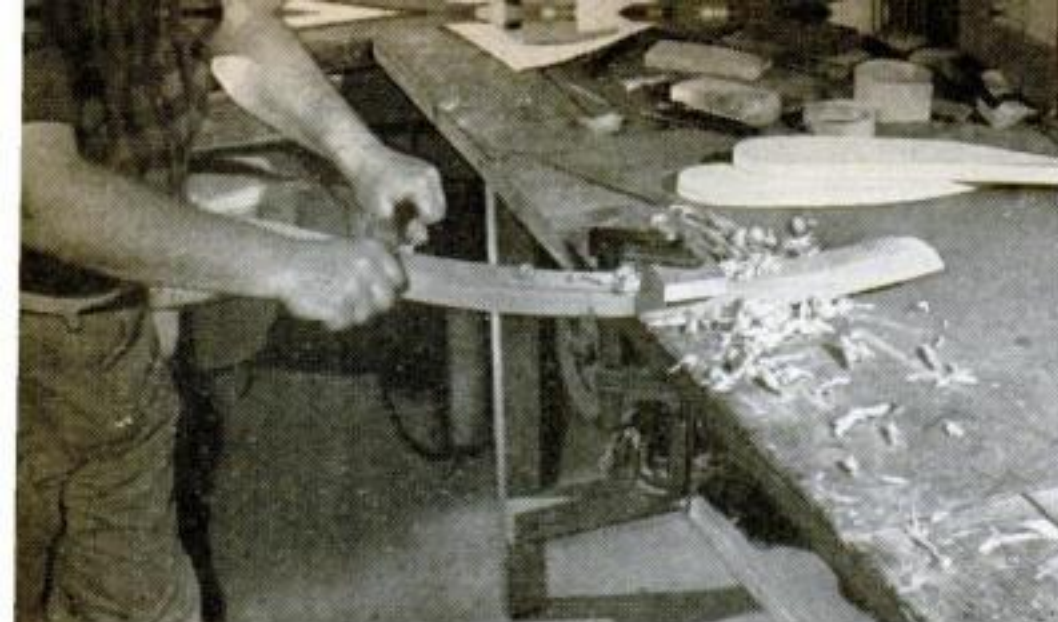
BEFORE CHISELING MORTISES and boring holes for rungs, study drawing and be *certain* you've laid out matching left- and right-hand posts. For mortises, bore short row of $\frac{1}{2}$ " holes, $\frac{3}{4}$ " deep, and chisel out wood between them.

BACKREST is made as a subassembly, since it's easier to weave cane over it before installing it in chair. After boring $\frac{1}{2}$ " holes in stretchers for shouldered ends of $\frac{3}{4}$ " dowels, round opposite edges and sand smooth.

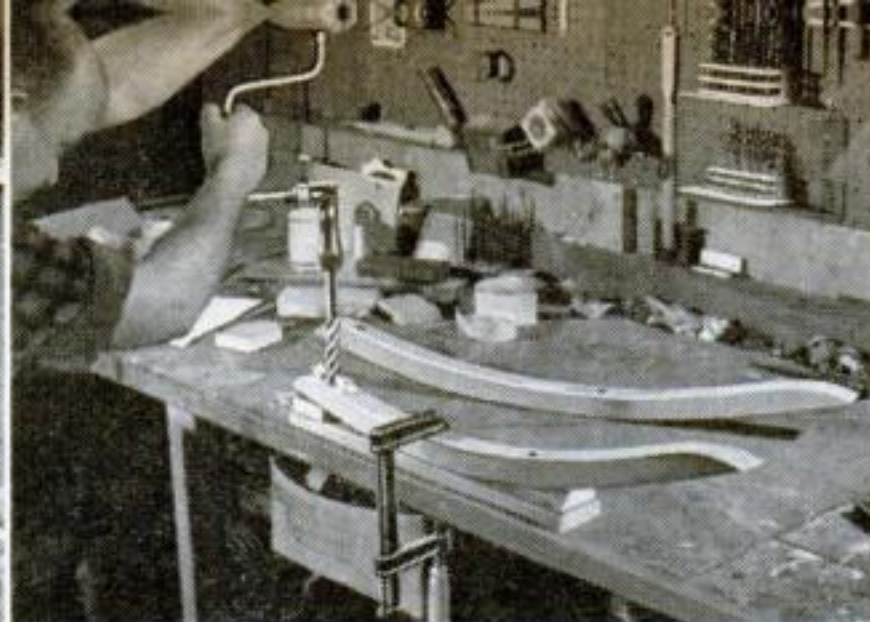
JOIN PARTS of seat frame with corrugated fasteners driven in from top and underside. Great strength isn't needed, as seat is supported by upper rungs. Frame is rounded at edges.

COPING OR KEYHOLE SAW can be used to cut armrests. Draw 2" squares on cardboard to make template. Smooth armrests with spoke shave and sandpaper; round narrow end to fit holes in rear posts. [Continued]





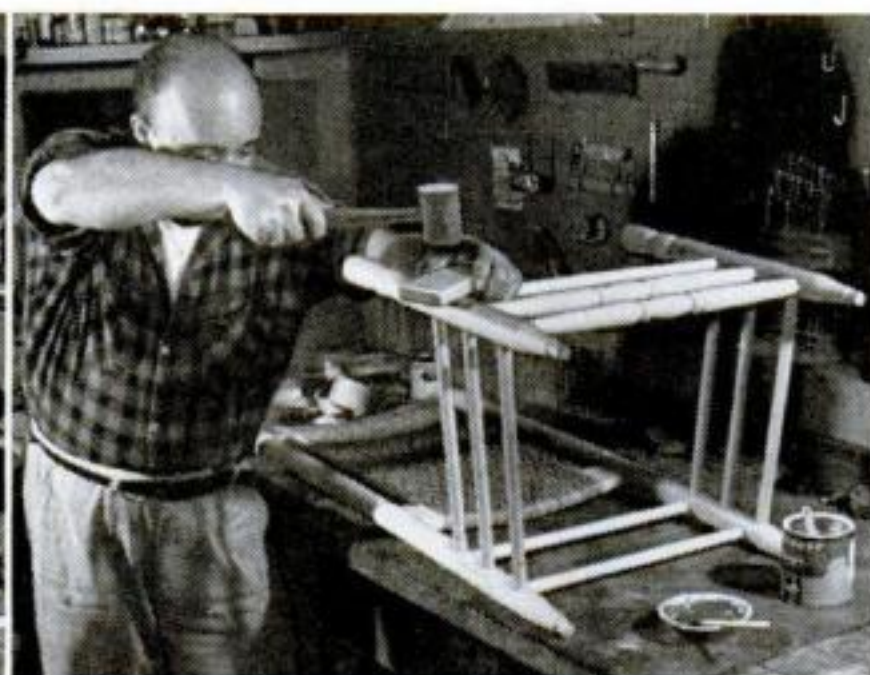
RUNNERS FOR ROCKER are hand-cut from clear-grained two-by-four, then dressed to pencil line with spoke shave. Stronger runners can be laminated by gluing and clamping three 1 5/8" strips of 1/2" plywood over a curved form.



SIMPLE JIG (see drawing) holds runner in proper position to permit boring holes with brace and bit held vertically. Maintain visual alignment with a square or some vertical object in the background while you bore 3/4" deep.



REAR POSTS are pressed on backrest tenons and rear rungs with two bar clamps. Lacking clamps, rope tourniquets could be used to squeeze parts together. Drive two nails through posts at each tenon before you release the pressure.

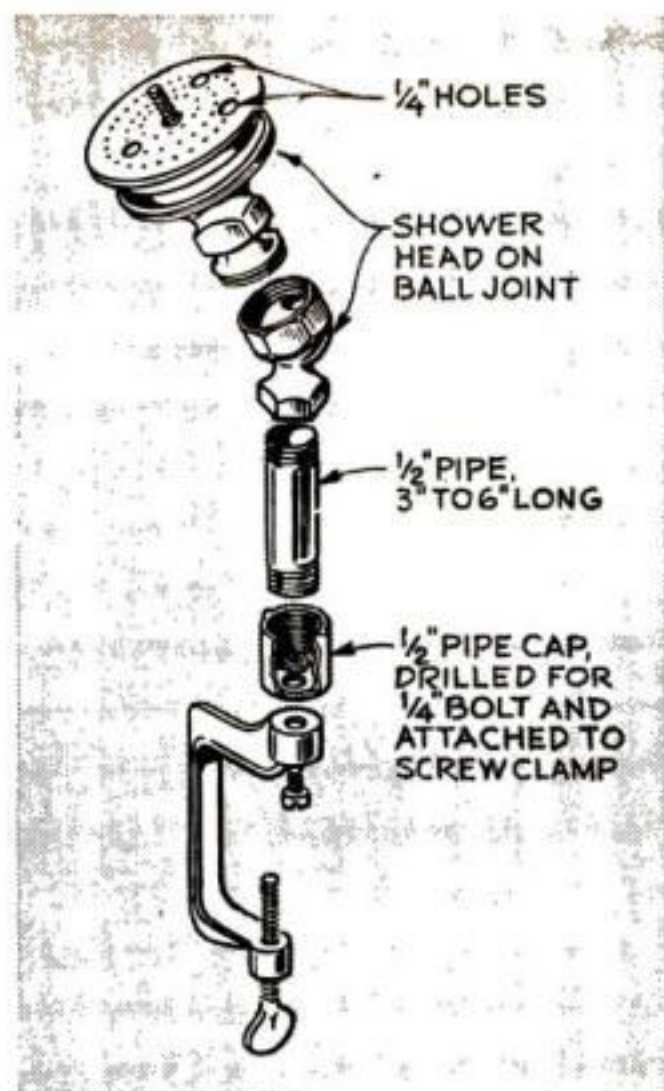


JOIN FRONT OF CHAIR TO BACK with side rungs. Waterproof glue is recommended but, before it sets, put the seat frame in place and press posts into holes in runners to be sure front-to-back dimension between posts is maintained.



READY FOR THE PORCH: Clear lacquer or spar varnish will seal wood and canework against the weather. For indoor use, Minwax or varnish stain can be applied to darken your rocker and blend it with other furnishings.





Work Swivels on Shower Head

SMALL parts can be turned to almost any working position on this swiveling work stand. It clamps to a table or bench top.

A small vise fastened to the shower head can be used to grip tiny objects, but isn't a vital need. I've used clamps, hooks, springs, even rubber bands to hold carvings, models, and plaques while I worked on them.—*Henri A. Fluchere, Irvington on the Hudson, N. Y.*

Short Cuts and Tips

FROM PS READERS



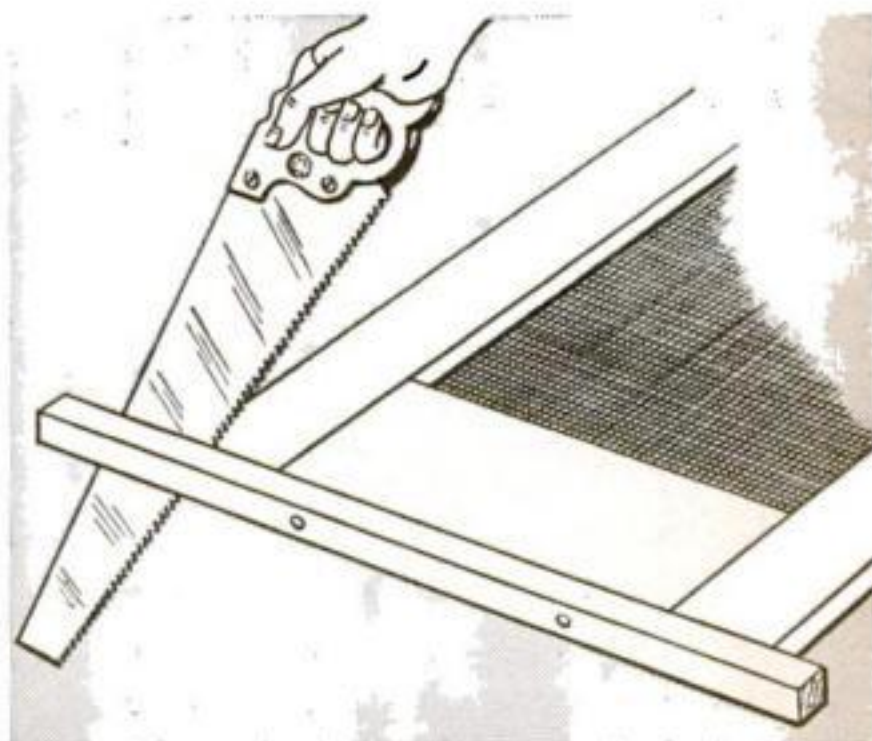
▶▶▶THE best way to save left-over paint in an opened can, I've found, is to float a disk of paper on top of the paint before storing it. The paper keeps out air and prevents the paint from drying out or forming a skin. Accurate disks can be made by tracing the can bottom onto newspaper, then cutting the circle slightly smaller so it will fit snugly inside the can.—*H. Rodemeyer, Rochester, N. Y.*

▶▶▶TO LOCATE the center of a dowel, bore a hole in a scrap of 1" lumber with an auger bit the same size as the dowel. Keep the bit at right angles to the surface, and when the point of its lead screw pierces the other side, back the bit out of the hole. Insert the dowel and mark the center with a brad tapped lightly through the lead-screw hole.—*Michael J. Whiteman, Brooklyn.*

Next Month:

How to Weave Cane for the JFK Rocker

Anyone can learn caning. For full details on how to weave a cane seat and back for the JFK rocker—or renew the canework on any old chair—see September POPULAR SCIENCE.



Strip Guides Saw for Trim Cuts

A wood strip nailed to the bottom of a swollen door makes it easy to trim the end grain of the frame. After cutting in from both sides, remove the strip and plane down the remainder of the edge.—*G. E. Hendrickson, Argyle, Wis.*



START ON STOMACH, weight on elbows, legs trailing, tow bar held at leading edge of disk. Have boat accelerate slowly or you'll be pulled off.



RISE TO KNEES as saucer begins to plane. Keep weight on back half; don't let front edge dip.



DRAW ONE FOOT UP to center in balanced crouch. Place so that feet will end up 12" to 18" apart.

STAND WITH KNEES FLEXED, leaning against pull to keep saucer tilted. Stay within wake, at first. (Demonstration photos courtesy Evinrude Motors.)

You're on your feet in 4 steps

**Water skis too expensive?
Try a homemade substitute**

Saucer Skimmer

FOR maneuverability, nothing beats a water saucer. Riding one is a low-speed sport that's safe for kids yet boasts plenty of thrills for adults. Any small boat with a 5½-horse outboard will tow this saucer at the recommended 10 m.p.h.

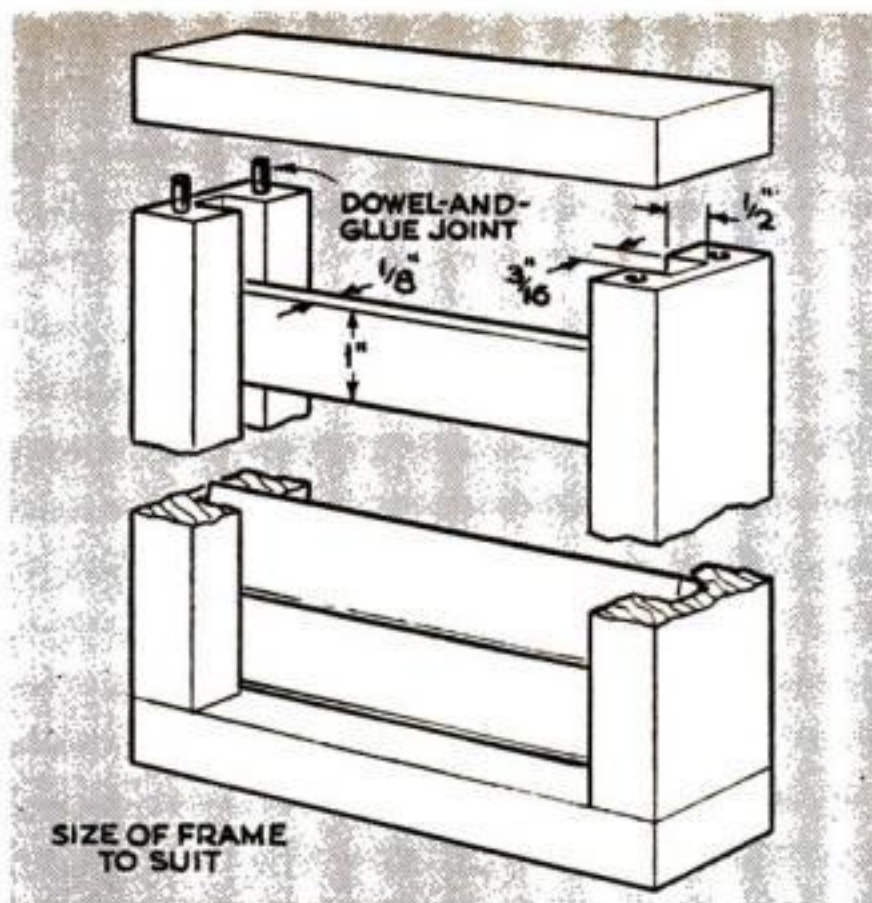
Cut a 3'-to-3½'-diameter disk from ¾" marine plywood, sand smooth, and apply one coat of sealer and one of marine paint. Then, on the top surface only, apply a nonskid paint (containing sand or cork particles) or a rubber mat. You'll need toe bindings only if you plan to take the saucer over jumps.

We give fair warning: It's easier to make than to ride. But a little practice tames its skittishness, and you'll soon be doing stunts like turnarounds and zigzags.



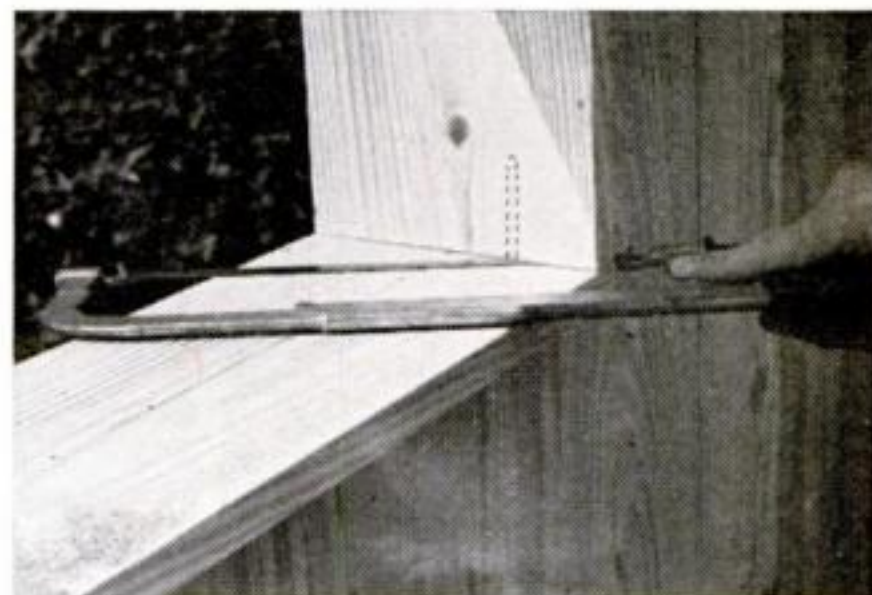
Short Cuts and Tips

FROM PS READERS



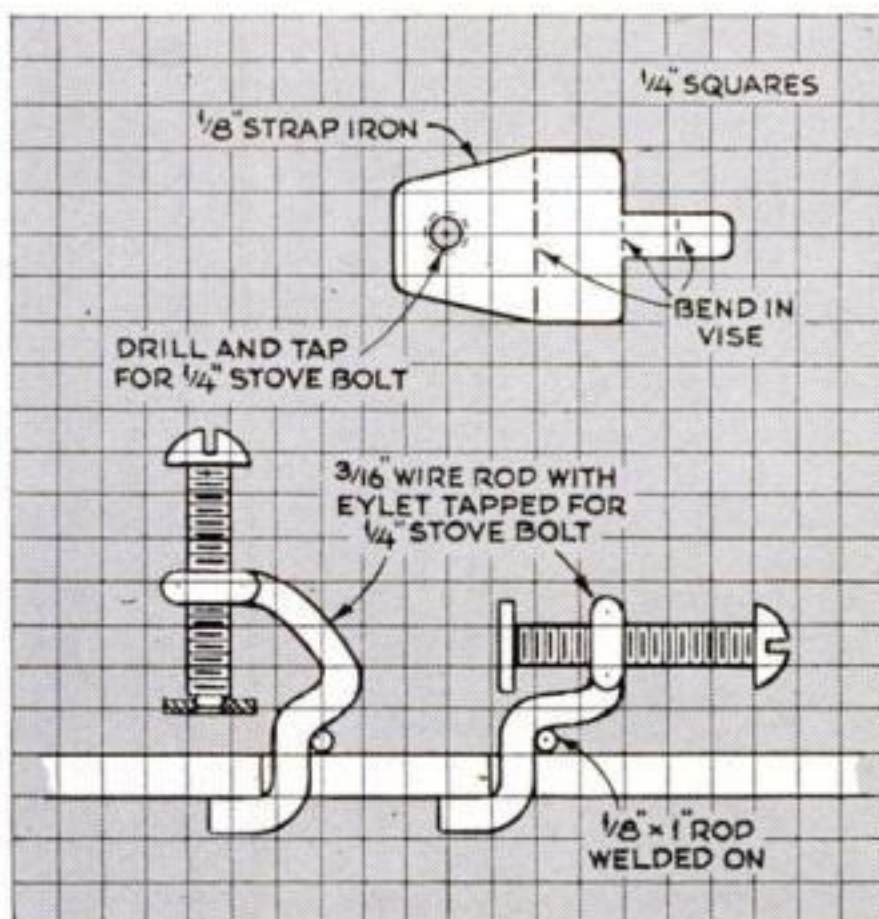
Louvered Panels the Easy Way

WHEN you make the frame for a louvered panel, cutting individual slots to take stationary louvers is a tedious job. In many cases, simple full-length grooves, slightly wider than the slat thickness, can be substituted. The slats tilt in the grooves, and their overlaps lock them in position once the top rail is attached.—*J. R. Pierpont, North Merrick, N. Y.*



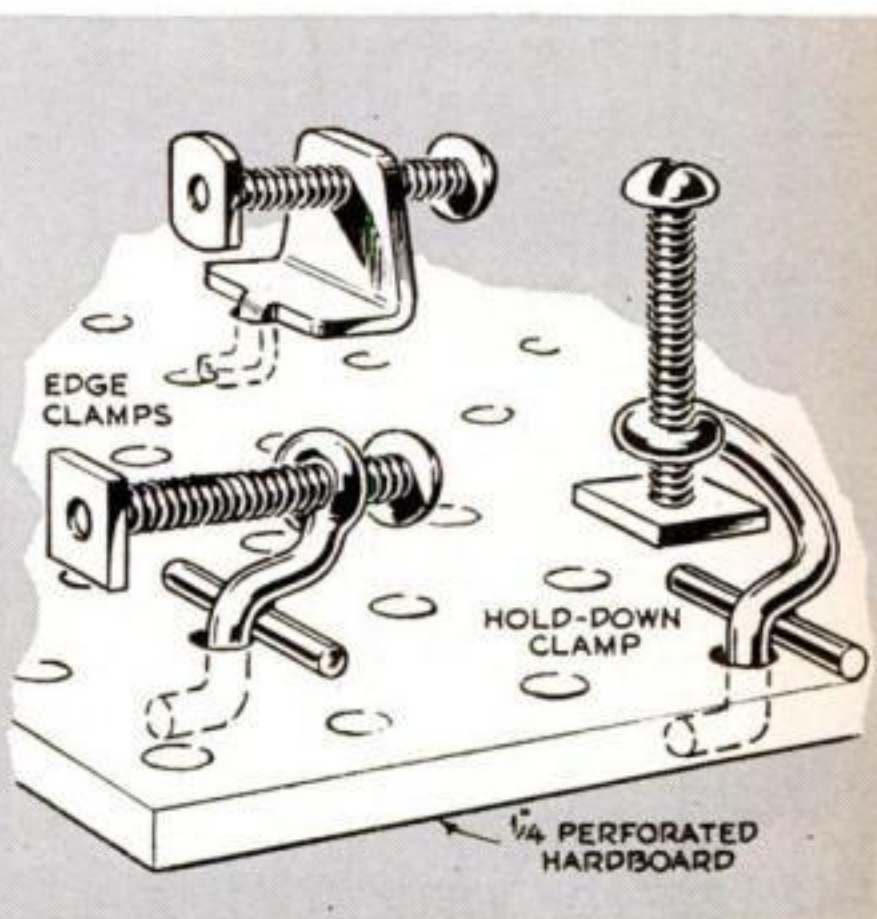
Restarting a Wrong Nail

A MISPLACED finishing nail is practically impossible to remove because the head sinks into the wood. The quickest way to correct an error is to pry the joint apart just far enough to slip in a hacksaw blade and saw the nail in two. The wood can then be shifted into correct position and renailed with no trouble.—*Jackson Hand, Westport, Conn.*



Clamping Jig for Small Parts

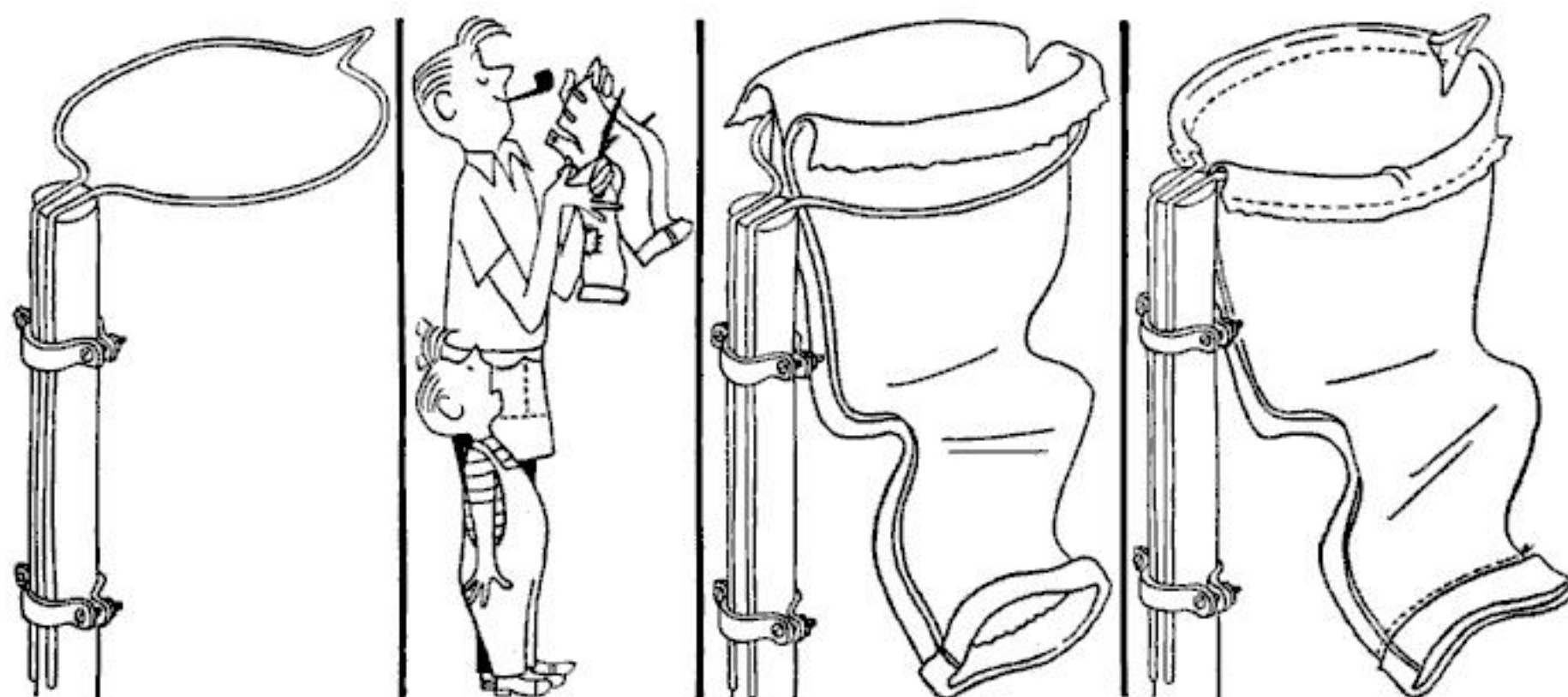
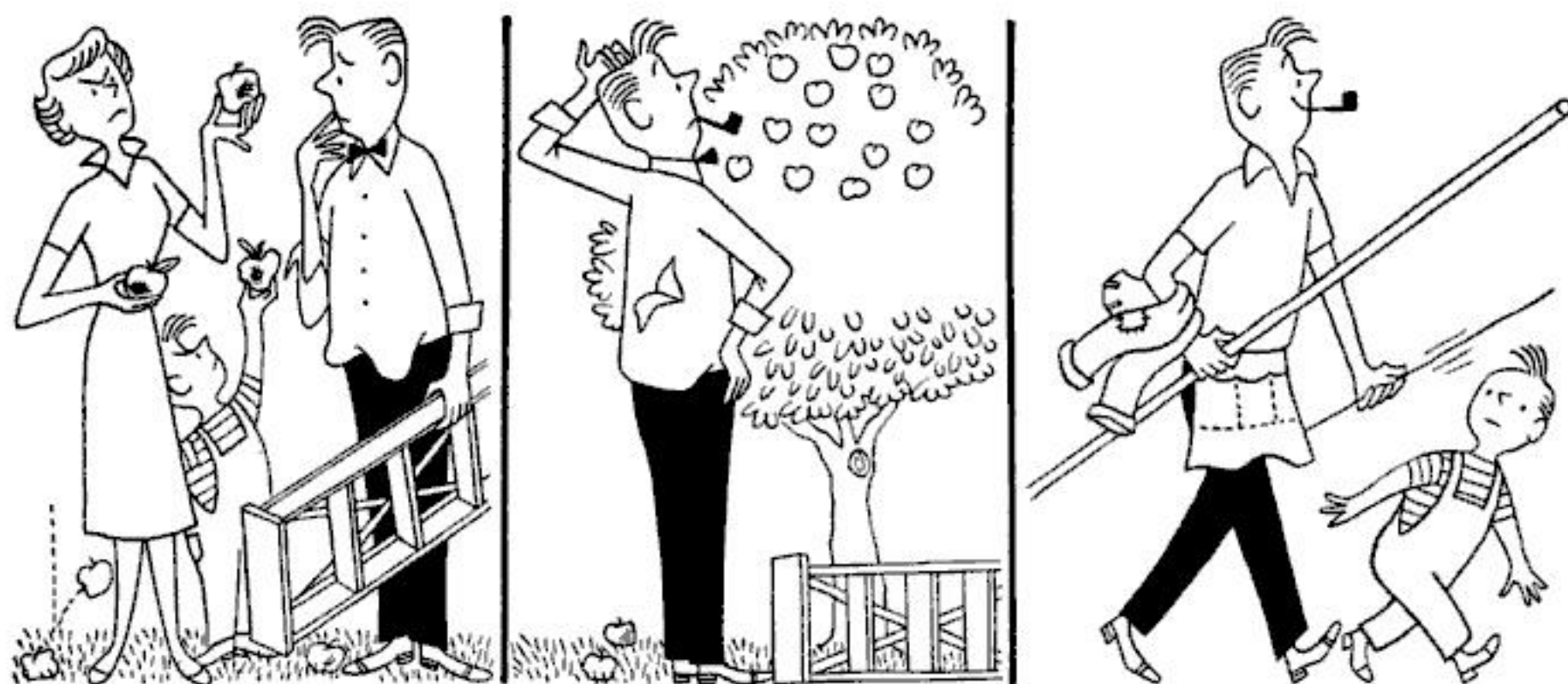
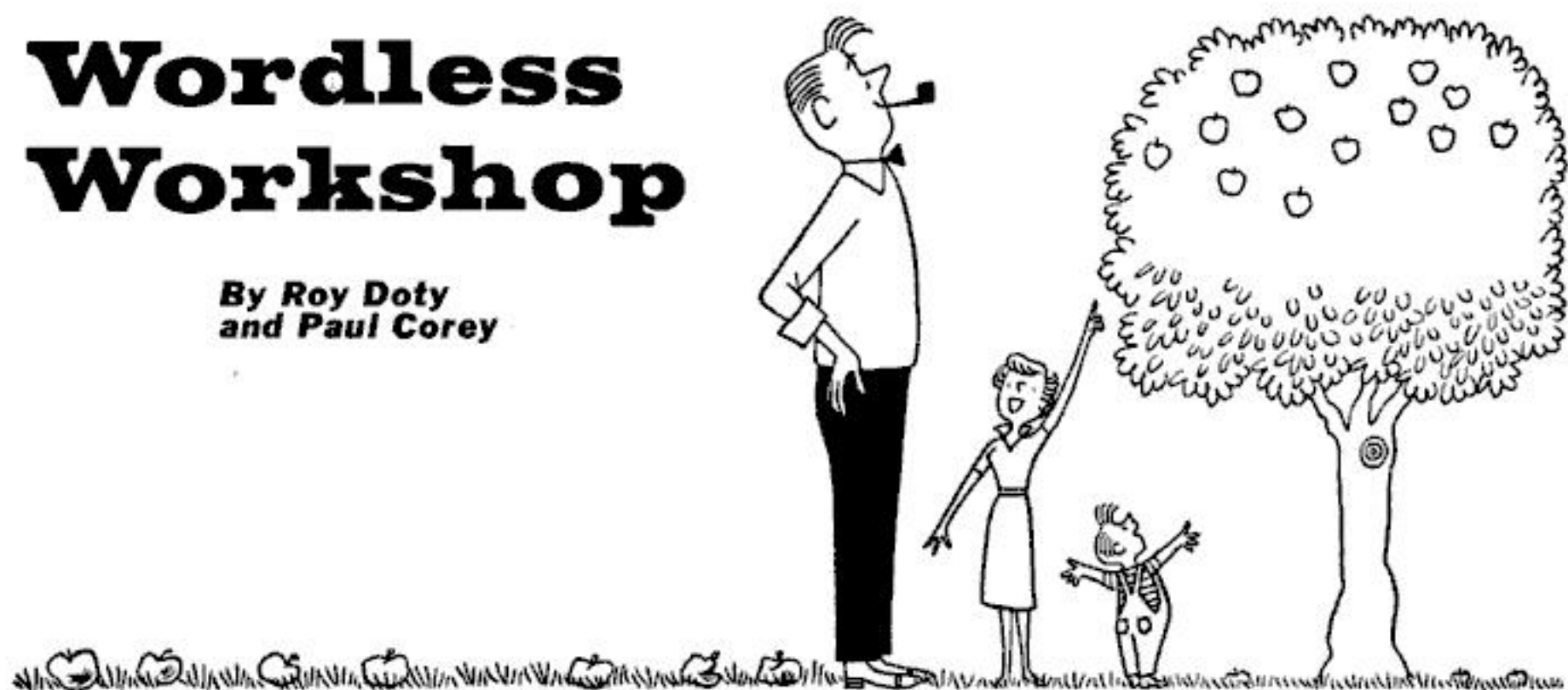
A PANEL of perforated hardboard becomes a versatile clamping jig when you make a few of these tiny, movable clamps. The hold-down type is for face-clamping stock up to 3/4". All three have strap-iron pressure plates pivot-peened to

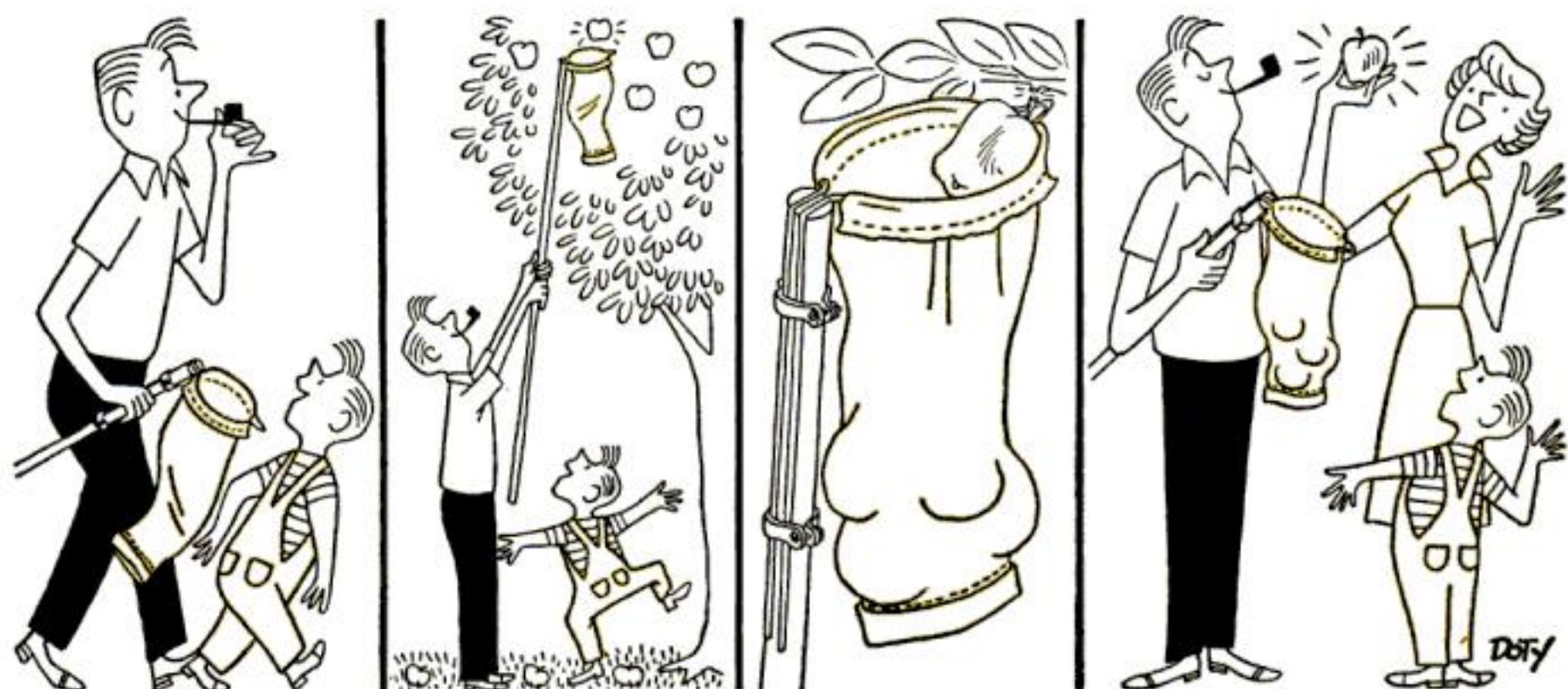
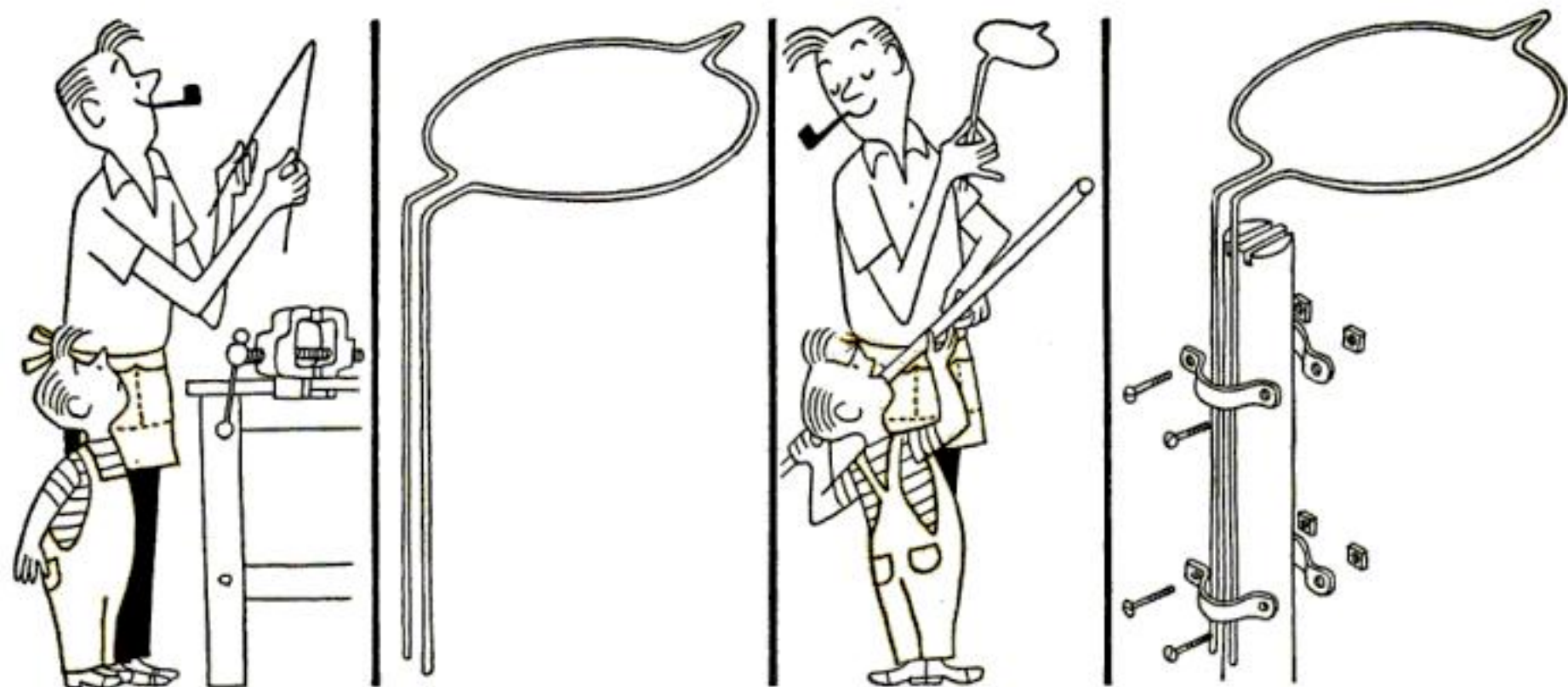
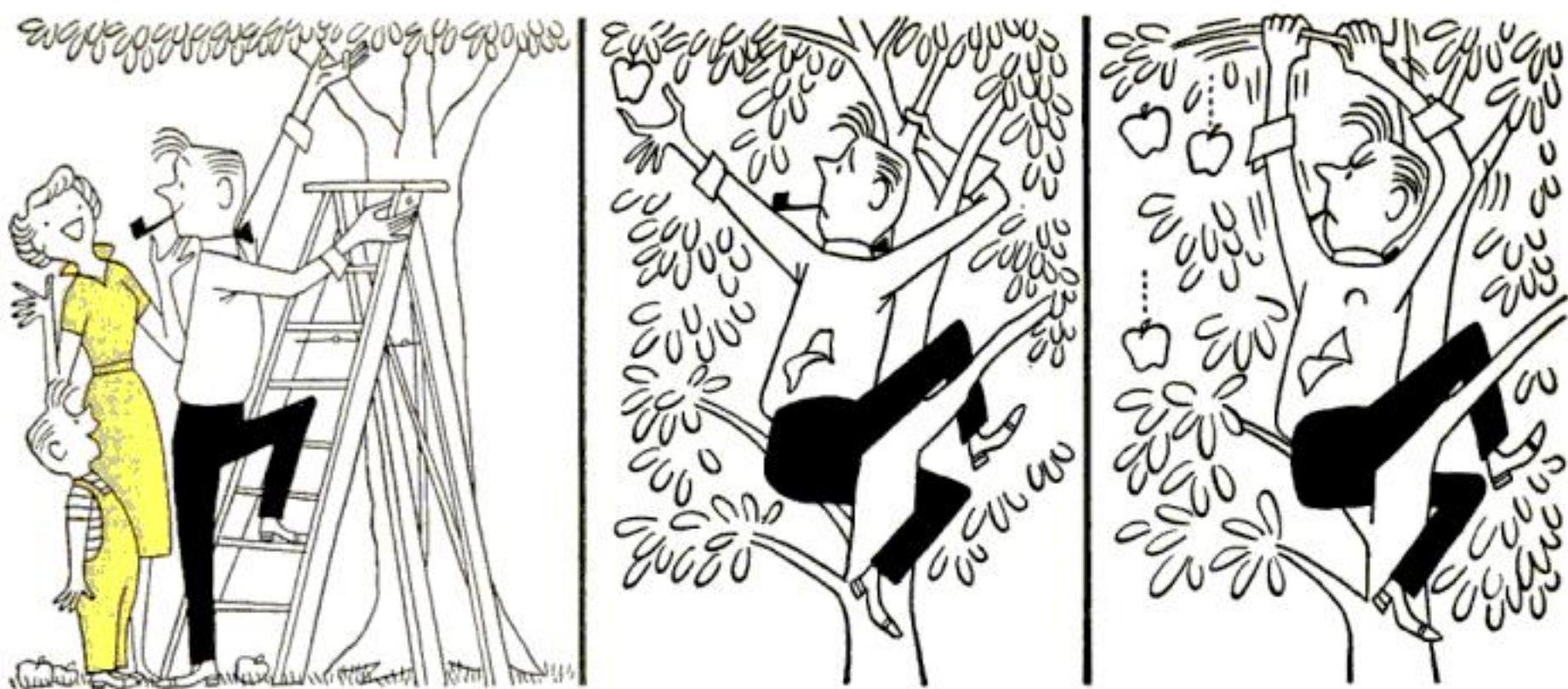


the ends of 1/4" bolts. To attach each plate, drill and countersink it. Tighten two nuts together about 1/8" from the bolt end, clamp them in a vise, and file the bolt end for a loose fit in the plate. Insert the bolt in the plate and flatten the tip inside the countersunk recess.—*D. Millard Lake, Osburn, Idaho.*

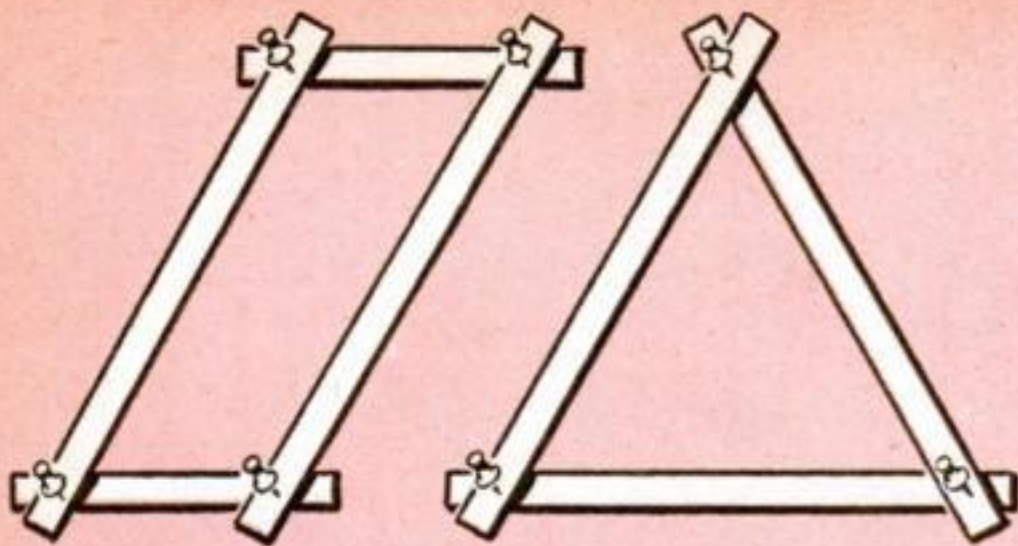
Wordless Workshop

By Roy Doty
and Paul Corey





Why an A-Frame Is So Strong



PIN FOUR STRIPS OF CARDBOARD into a square and you'll see how easily they can be squashed flat, as at far left. Triangle at near left, however, can't be budged in any direction even though each corner is held by only a single pin. The reason: In a triangle, no angle can change without changing the length of the sides. Since the sides can't change, the shape can't change. In a square, the angles can change even though the sides remain the same.

Why the Big Boom in A-Frames?

High strength and low cost make these rakish designs top choice for a home-built vacation cabin

By Sheldon M. Gallager

THAT dream of a summer home may come true sooner than you think. A new concept for building vacation cabins now makes it possible to own your own beach cottage or mountain retreat for the price of a new car—in some cases, less.

The secret is a simple A-frame design, long known by architects to be one of the strongest, easiest, and most economical structures you can build. Used for generations by Indians and trappers in the heavy snow regions of the north, the rugged A-frame has now been slicked up and turned into a fascinating new type of "second home."

The A-frame is so flexible it can be whatever you want to make it—a summer fishing cabin, a winter ski lodge, a garden shelter, even a boat port. You can build it any size and in a variety of exciting shapes without changing its basic construction principles.

Strong, yet easy to build. An A-frame is simple—it's just a triangle. You can assemble all the frames for a cabin right on the ground and put them up in one operation. A good-size cabin may have as

few as four or five frames, connected only by the siding you stretch across them. Tricky gable-roof framing is eliminated.

An A-frame is actually a truss—the strongest-known construction principle. Its tall, sharp-peaked shape shrugs off snow, ice, and rain, making it an ideal foul-weather shelter in cold regions. In hot areas, the high roof keeps you cool. The steep sides are so weatherproof that they save you costly roofing. Often, the only roofing used is exposed boards.

Because of its built-in strength, an A-frame requires fewer and lighter structural members than a conventional house of the same size. The A-frames are also self-supporting—there are no interior posts or walls to interfere with living space.

If you want an upstairs, it's easy to run beams across the midpoint of the A-frames to provide a floor. A common practice is to leave the living-room area open to the roof and run a half-floor, or sleeping loft, over the rest of the cabin. Low-headroom areas are put to use in the same way as in an attic—by tucking closets, counters, bunkbeds, and other built-ins into them.

With a compact arrangement like this, you can squeeze a living room, bath, kitchenette, and one or two bedrooms into a floor space 20' by 22'. You can also build an A-frame in easy stages, add-



ROOMY INTERIOR shows cozy fireplace at right, compact kitchenette at rear. Low wall serves as both a lunch counter and room divider. Complete plans for the design, called "A-Frame Beach Cabin," are available from the Douglas Fir Plywood Association.

MODERN-STYLE A-FRAME, this swank beach or mountain cabin boasts a cantilevered sun deck and flying balcony. Only 24' square, it has a kitchen, bath, and large living room downstairs, two bedrooms upstairs. The roof-walls are simply two-by-sixes covered with $\frac{3}{8}$ " plywood panels and watertight batten strips. The floor is supported on nine piers made by filling 12"-diameter sewer tiles with concrete.





THIS PREFAB CABIN comes as a kit, has no structural beams except in the foundation. Floor and walls are stressed-skin panels of plywood over two-by-four frames with built-in insulation. Standard size is 16' by 24' with 9'-by-12' sleeping loft for \$2,300. Additional panels are available for extending the cabin to any length. The kit is sold by Sandpoint Builders Supply, Mountlake Terrace, Seattle, Wash.

ONE OF THE EASIEST TO BUILD, this garden shelter or pool cabana uses light, two-by-four studs, needs no floor or foundation. Studs rest on small individual piers and are covered with redwood siding, making roofing unnecessary. The canopy of corrugated plastic lets in light but sheds rain. Free plans for the garden shelter are available from the Simpson Timber Co.

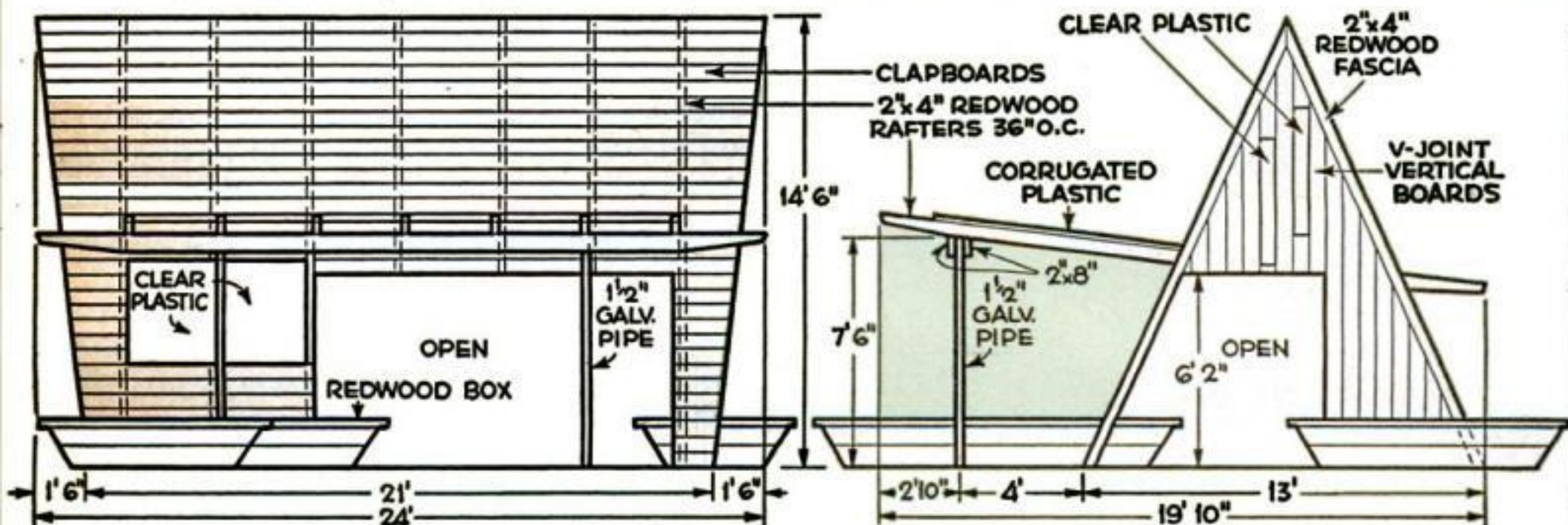
ing extra frames as you need more space.

How A-frames are built. The most common shape is a triangle with 60-degree angles at base and peak. This makes all three sides the same length, simplifying the ordering and fitting of lumber. Often you can size the cabin to take advantage of stock lengths and eliminate cutting. For greater headroom, the base angles can be increased to 65 or 70 degrees, providing a taller triangle.

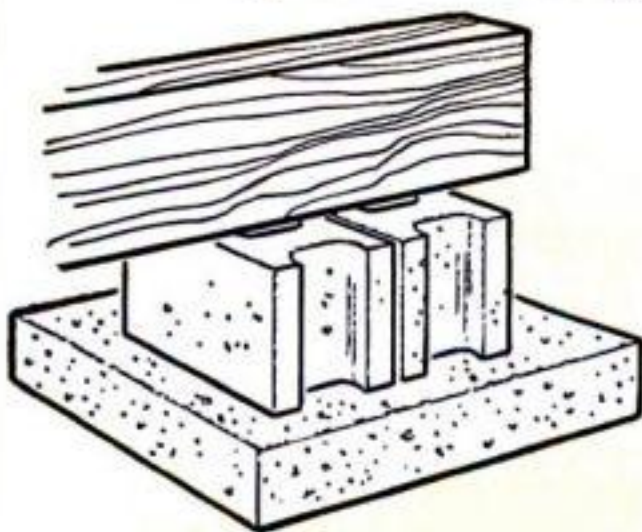
Because of the sloping sides, the overall height of an A-frame must be somewhat greater than that of a conventional design. One-story cabins are generally 12' to 16' tall at the peak, two-story cabins 20' to 22'. These taller sides offer a bigger wind target than an ordinary house and may flex a bit. To avoid this, designers recommend adding cross-braces in high-wind areas, similar to attic collar beams. In a two-story cabin, the upstairs floor serves the same purpose.

The roof and floor beams are generally heavier than those in conventional construction, but are spaced farther apart.

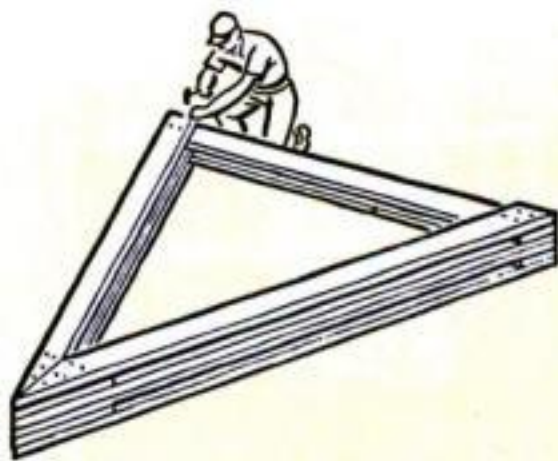
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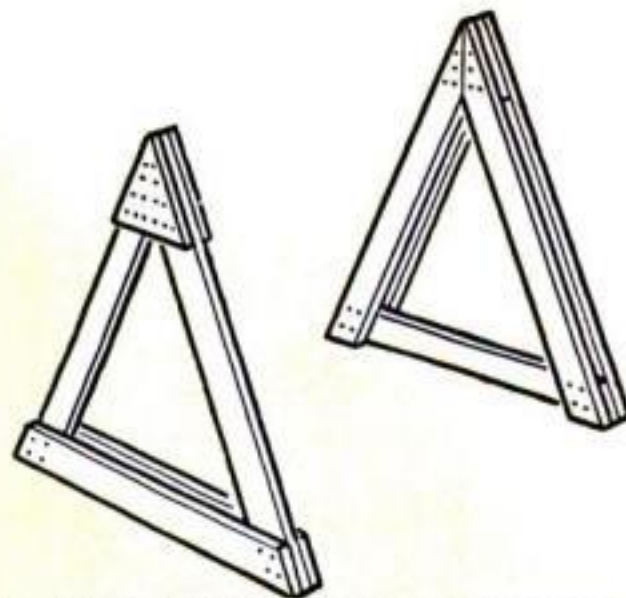
Why an A-frame goes up so fast



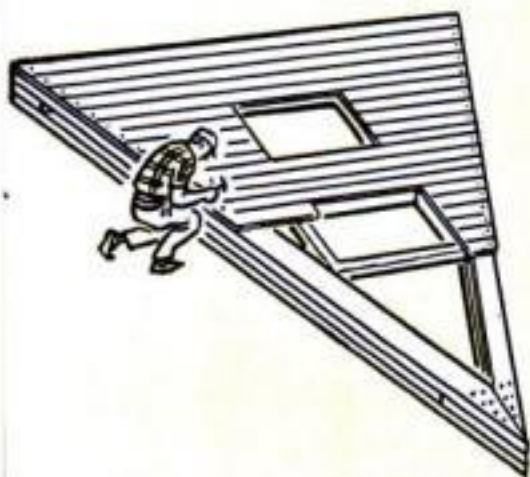
SIMPLE FOUNDATION requires only a few main beams supported on concrete-block piers. The blocks, usually two side by side, rest on concrete footings that go below the frost line.



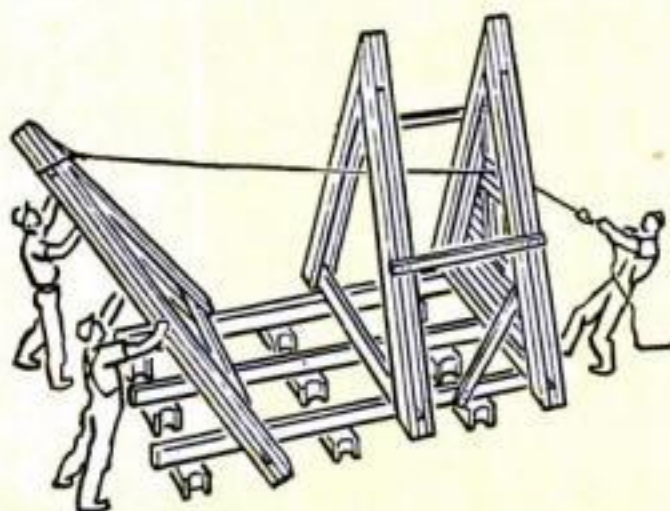
A-FRAMES CAN BE PREFABBED on the ground unless very heavy beams are used. Each completed frame then serves as a pattern to insure fast and accurate alignment of next one.



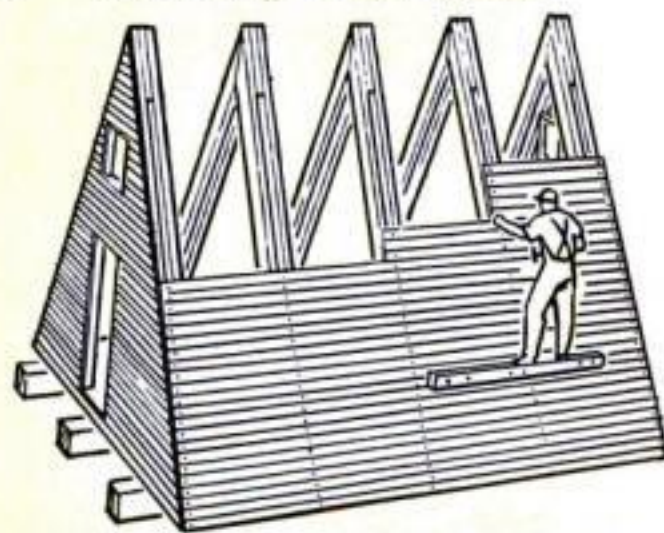
TWO EASY WAYS to get strong, interlocking joints: At left, single wall beams are straddled by doubled floor beams. At right, doubled wall beams straddle a single floor beam.



END GABLES can also be pre-assembled, complete with siding and door and window openings. This makes it easy to frame openings accurately without climbing around in mid-air.



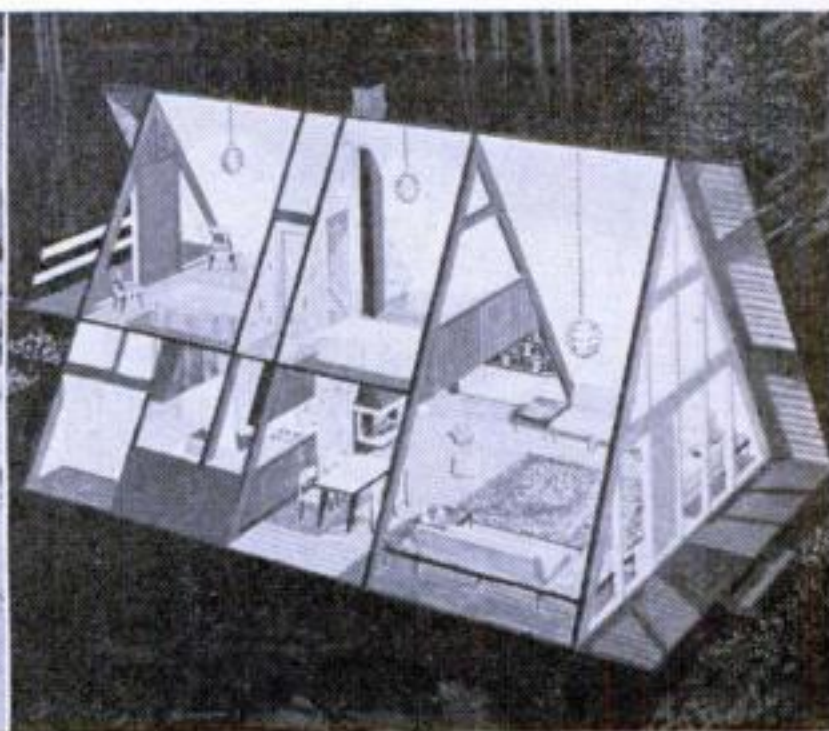
FRAMES ARE HOISTED UP one at a time and held temporarily in place by diagonal braces. Two persons with a third helper pulling on a line can raise all but the heaviest A-frames.



WITH FRAMES IN PLACE, exterior panels or siding are nailed on to complete the shell in as little as six hours. Temporary cleats nailed to roof let you walk up the steep sides.

YOU GET A BUILT-IN BOAT PORT and an over-water deck in this unusual shoreside design. Despite its size—about 32' by 36'—materials cost only an estimated \$2,500 to \$3,000. Note that here the A-frames are unbalanced, with legs at the rear longer than those in front. This gives extra headroom over the living area, with low-ceiling sleeping space in back. Plans for this "Shoreside Homarina" are available from Douglas Fir Plywood Association for 25 cents a copy.

SLEEPING LOFT squeezes two extra bedrooms into this compact A-frame only 23' by 36'. Note striking wall of glass at one end, cantilevered balcony at other. Wide spacing of frames is made possible by using extra-thick wood decking on walls and floor. Plans (No. 426), designed for Potlatch Forests, Inc., are available from Home Building Plan Service.



Many shapes are possible with a basic A-frame



OPEN-SIDED VERSION creates a porch along full length of cabin with sheltering roof overhang above it. Plans (No. 418-1) are available from Home Building Plan Service.



ADDING TWO SHED-TYPE WINGS to a central A-frame provided the unusual roomy design above. Plans for this "Douglas Fir" model are available from Vacationland Homes Plans.



INTERSECTING A-FRAMES produce these eye-catchers. Vertical walls increase headroom. Plans available from Vacationland Homes Plans (left) and Home Building Plan Service (right).



VERTICAL SIDES give this design a conventional look, yet retain strength and simplicity of A-frame design. Plans (No. 419-1) are available from the Home Building Plan Service.

EXTENDING A-FRAMES beyond the main cabin adds convertible outdoor space—open for sun or shaded by canvas panels. Plans ("The Ranger") are from Douglas Fir Plywood Assn.



Roof rafters are frequently two-by-eights or two-by-tens, doubled to give a 4" thickness; floor joists are doubled two-by-tens or two-by-twelves. The most common spacing is 4'.

In most designs, the roof rafters are tied directly into the floor joists by overlapping the ends and side-bolting or nailing through the laps. The result is an absolutely rigid structure.

How you can get an A-frame. Complete architect's plans are available for most of the designs shown here. You can also buy complete cabins as kits. Parts are all pre-cut—you just put them together. Heat, plumbing, and other facilities are added by local contractors.

By doing the work yourself, you can often keep the cost to \$2,000 or under on a small cabin. Newly created "second-home" loans are making it possible to finance up to the full cost.

More than 100,000 vacation homes were built last year alone, many of them A-frames. This year's crop is expected to hit half a million. Builders are predicting that the second home will soon become as important a part of leisure living as today's second car. Add up what you spend on yearly vacation trips and you can see why owning your own year-round resort makes sense. ■ ■

Where you can get plans for A-frame vacation cabins

Douglas Fir Plywood Association, 1119 A St., Tacoma 2, Wash. Catalogue available for 25¢. Individual architect's plans also available for 25¢ each.

Potlatch Forests, Inc., Lewiston, Idaho. Catalogue available for 50¢. For full plans, see Home Building Plan Service below.

Home Building Plan Service, 2454 N. E. Sandy Blvd., Portland 12, Ore. Architect's plans for \$27.50 to \$37.50.

Simpson Timber Co., 2042 Washington Bldg., Seattle 1, Wash. Free plans for A-frame garden shelter.

Western Pine Association, Yeon Bldg., Portland 4, Ore. Catalogue available free. For full plans, see Vacationland Homes Plans below.

Vacationland Homes Plans, P.O. Box 4379, Portland 8, Ore. Architect's plans for \$5 each.

**POPULAR SCIENCE
TACKLES**

A Major Housing Problem

On the 21 pages that begin here, everyone who lives in a house will find dozens of money-saving tips on a topic of mounting importance:



Keeping Down the High Cost of Humidity

DESTRUCTIVE humidity hits you squarely in the pocketbook. If you don't believe that simple statement, consider what it costs you when:

- The paint peels off your house.
- Costly tools and appliances rust.
- Furniture falls apart.
- Walls rot and plaster cracks.
- Expensive furnishings dry out.

These are only a few of the harmful effects that rob you of money and comfort when you have too much, or too little, moisture in your home. They're part of the price you pay for progress in modern house construction. Indoor hu-

CONTINUED

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midity is now the problem of every home owner.

This wasn't always true. In the old days, a house didn't seal out Nature with weatherstripping, calking, insulation, double-glazing, and the tight construction now possible with precision-milled lumber and building panels.

Older houses breathed; today's can't. To make matters worse, we've moved into areas never intended for living—the attic and the basement. We've added many moisture-producing devices, including the modern shower. We now do laundry in the living area—and play in the laundry area. Ironically, despite all this moisture, modern heating and tight construction also produce “winter dryness”—equally harmful.

We've upset the balance of Nature. To correct it, we must create our own indoor climate. Just as we now take the thermostat for granted to control heat, the modern humidistat is becoming equally essential to control humidity.

Moisture control is a new concept. Much of the information about it is misleading, confusing, or incomplete. Some of the claims of “wonder devices” for your home are sheer nonsense.

On the following pages, POPULAR SCIENCE has assembled the latest facts on the whole question of moisture control—what the real problems are, what causes them, what you can do about them. Knowing the answers will save you money and add to your comfort all the months of the year.

As a start, run through this check list to see where your major problem, or problems, may be.



The humidistat—as vital in modern homes as your thermostat.

The HUMIDITY in your home is . . .

too LOW if:

- ☐ Floorboards separate, creak
- ☐ Doors and windows rattle
- ☐ Piano goes flat
- ☐ Food dries out
- ☐ Veneers peel
- ☐ Leather dries out
- ☐ House plants wilt
- ☐ Your nose feels dry
- ☐ You get colds often
- ☐ Static sparks are common
- ☐ Wallpaper loosens
- ☐ Bookbindings crack
- ☐ Oil paintings check
- ☐ Moldings shrink
- ☐ You keep shivering, even with thermostat set above 75 degrees
- ☐ Rugs wear fast because fibers become brittle and break loose

too HIGH if:

- ☐ Floorboards warp and cup
- ☐ Doors, drawers stick
- ☐ Piano goes sharp
- ☐ Food spoils quickly
- ☐ Plywood layers separate
- ☐ You feel hot and sticky
- ☐ Leather mildews
- ☐ Windows steam up
- ☐ Bath towels remain damp
- ☐ Water pipes sweat
- ☐ Exterior paint blisters
- ☐ Brick mortar crumbles
- ☐ Tools corrode, dull quickly
- ☐ Wood is hard to work
- ☐ Condensation drops from protruding nails in attic and freezes
- ☐ Damp spots appear on ceilings, interior surface of outside walls

PAIN T INSIDE...



a practical
solution to a
HUMIDITY
problem

when outside paint blisters

PAIN'T won't stick to a wet surface. That's why house paint sometimes blisters and peels off. Moisture produced inside the house seeps through the walls, spoiling the paint, causing stains, and rotting the wood.

A vapor barrier is the cure for this. But a barrier can be installed satisfactorily only during original construction. It goes inside the stud spaces of exterior

walls. Its job is to seal hollow spaces against the great quantities of moisture produced inside the house.

But what if you live in a home without a barrier? There are several things you can do. First, good ventilation can help eliminate excess moisture. And you should also consider a mechanical dehumidifier. These problems, of ventilation and dehumidification, both go hand

Why there's so much moisture in your home

HOUSE PLANTS PUT BACK INTO AIR AMOUNT OF WATER APPLIED TO THEM

OPEN AQUARIUM (AMOUNT DEPENDS ON SIZE)

BREATHING AND PERSPIRATION-3 TO 4 PINTS PER DAY

LEAKY RADIATOR VALVE (AMOUNT DEPENDS ON SERIOUSNESS AND CONSISTENCY OF LEAK)

UNCOVERED EARTH (CAN BE AS HIGH AS 100 PINTS PER 1000 SQ. FT. PER DAY)

DRIPPING FAUCET (SPATTERED DROPS ENCOURAGE EVAPORATION)

SHOWER - $\frac{1}{2}$ TO 1 PINT

BATH - $\frac{1}{8}$ PINT

CLOGGED CHIMNEY

CHIMNEY WITH NO (OR FAULTY) FLUE LINING

HOW MUCH MOISTURE is created every day by ordinary family activities? Lots—as this drawing shows. Less-obvious sources are unvented heaters and crawl spaces. Even a clogged or unlined chimney can let furnace moisture seep into the house.

UNVENTED SPACE HEATER - 88 PINTS FOR EVERY 1000 CU. FT. OF GAS BURNED
UNVENTED ATTIC

COOKING - 5 PINTS PER DAY

DISH-WASHING - 1 PINT PER DAY

FLOOR WASHING - 3 PINTS PER 100 SQ. FT.

UNVENTED GAS REFRIGERATOR - $\frac{1}{8}$ PINT PER HOUR

OIL FURNACE - 8 PINTS PER GAL. OF FUEL. GAS FURNACE - 7000 PINTS PER HEATING SEASON

UNSURFACED CONCRETE

LAUNDRY (DRIED ON LINES OR IN UNVENTED DRYER) 25 TO 30 PINTS

CONTINUED

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in hand with vapor barriers. Even when a barrier seals moisture inside a home, you still have to get rid of it.

Second, and most important, you can add a substitute barrier. You can actually paint a vapor barrier on the inside of your walls. Special paints are now made for this purpose.

In some parts of the house, you may also find it possible to install a regular sheet-type barrier. Kitchens and bathrooms produce the greatest percentage of a home's moisture. If you're remodeling either one, you should consider stripping off the original wall covering and installing a barrier. Whenever you put up wood or other paneling, you can also cover the old wall with a barrier first.

Barriers can be paraffin- or asphalt-coated paper, aluminum foil, or polyethylene film. Ideally, they should be built right into the wall, as close to the warm (interior) side as possible. The sheets can be applied separately, before the surface covering. Or they can be an integral part of blanket or batt insulation, or of panel materials.

Why humidity needs a barrier. Air can hold only so much moisture at a given temperature. It can hold more moisture when it's warm than when it's

cold. Chill it, and it will "dump" the excess moisture it can no longer hold, in the form of condensation.

Relative humidity is the percentage of moisture that air is actually holding at a given temperature compared with the total amount it is able to hold. The higher the relative humidity goes, the closer the air gets to its dump point (dew point). Any cooler surrounding surface will trigger the dump.

This is what happens when warm, moist house air meets your outside walls on a cold day. Suddenly chilled, it deposits its excess moisture on the nearest thing handy—your wall studs, sheathing, and siding. Rot sets in. The moisture, trying to escape outdoors, literally pushes the paint right off your house.

While relative humidities are higher in summer, the problem is not as serious because your outside walls are just as warm as the inside of your house and won't cause condensation.

Paint-on barriers. It may sound like a paradox to recommend painting *inside* to prevent peeling *outside*, but it's the logical answer when there's no other way to add a vapor barrier. An impervious paint on the inside of a wall keeps moisture vapor from seeping through and condensing on the sheathing or siding.

It's vital, however, that a barrier paint be used *only* on the inside. Put it on the outside of a wall and it will trap the moisture inside the stud spaces.

Several types of paints will serve as vapor barriers:

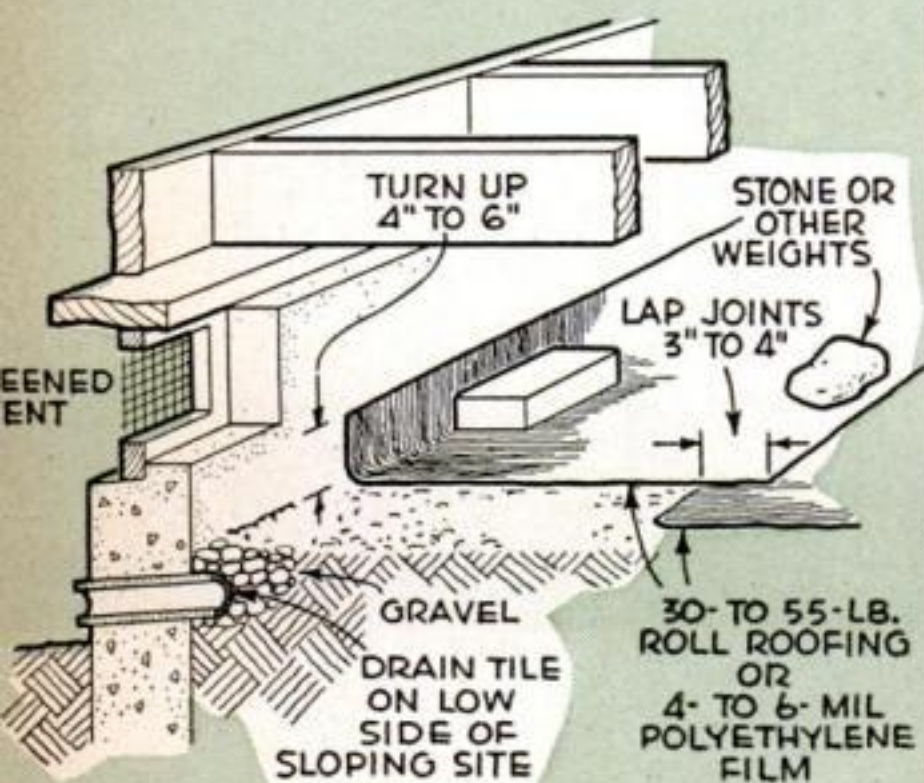
- Aluminum primer, plus one or two finish paint coats.
- Oil-base primer-sealer, plus two coats of semigloss paint or enamel.
- Rubber-base paints in sufficient coats to produce a smooth, glossy surface.

Calcimine, casein, and water-emulsion paints are of no value; nor is linseed oil. The vehicle, not the pigment, is the important factor. The choice of paint depends partly on whether your barrier coating is also to serve as the final wall finish. It doesn't have to. Decorative paint or wallpaper may be applied on top of it without affecting its efficiency as a vapor barrier.

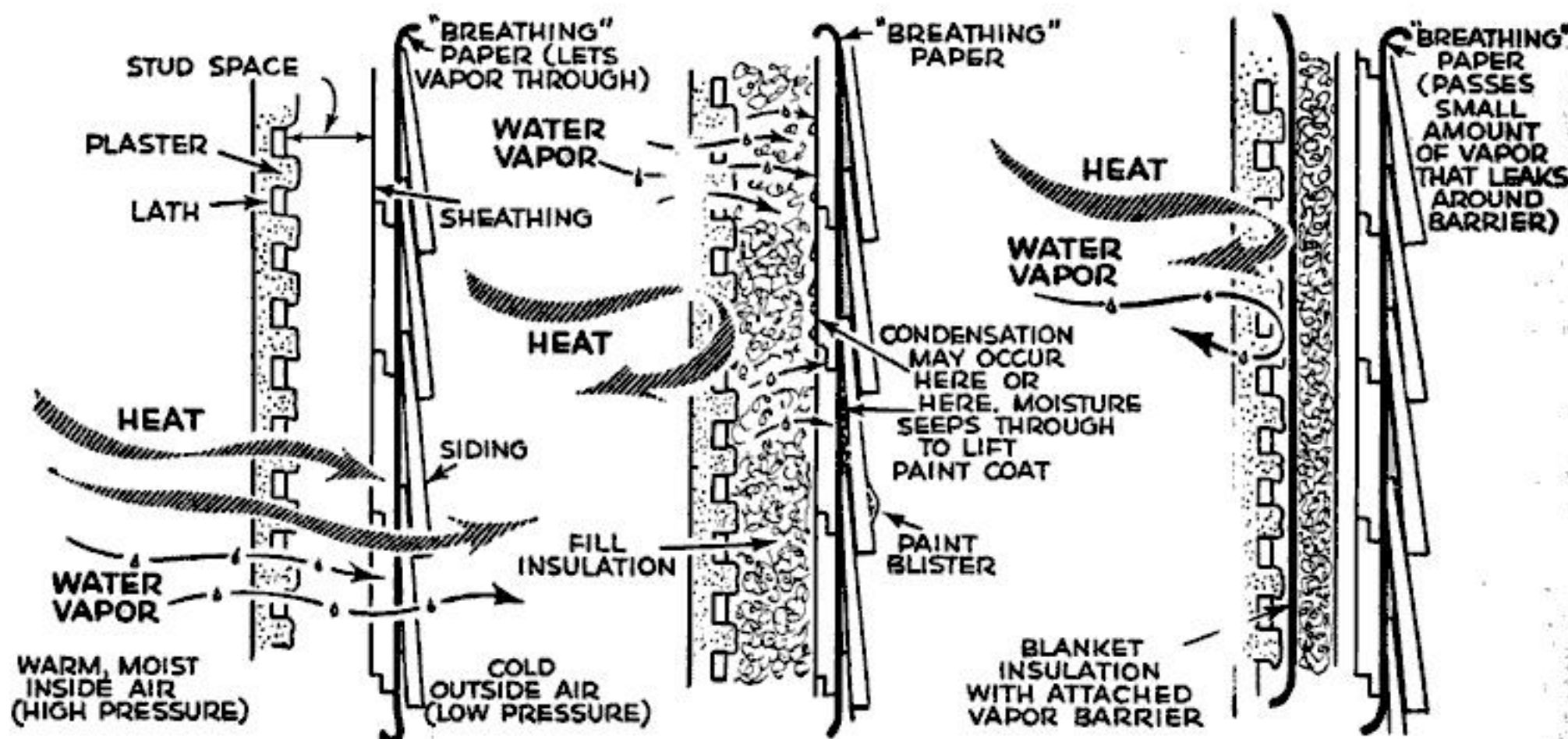
This efficiency probably won't be as high as that of a regular sheet barrier, but it should handle interior humidities of about 30 percent during normal winter

How you seal crawl spaces

MOISTURE FROM EARTH in a crawl space may condense on floor or pass into house. Simplest ground cover is a gravel bed 4" deep; each stone should be $\frac{1}{8}$ " in diameter or more. Sheet covers are more effective: mineral-surfaced roll roofing, or fungus-resistant plastic film. If space is used for storage, a waterproofed concrete slab will make the most durable barrier.



Why vapor barriers are important in modern insulated homes

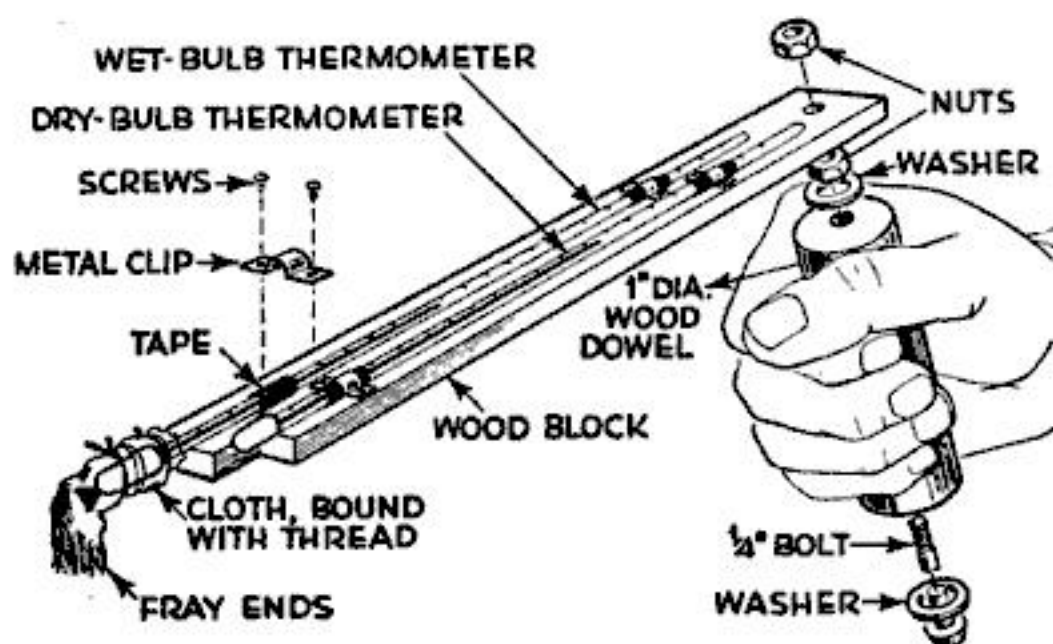


IN OLDER HOMES without insulation, the heat loss keeps outer siding and sheathing warm enough so that moisture usually won't condense. Water vapor thus flows harmlessly outdoors.

INSULATION in newer homes creates a problem because it holds the heat in, leaving outer side of the wall cold. Moisture flows into stud spaces and condenses, causing paint to peel.

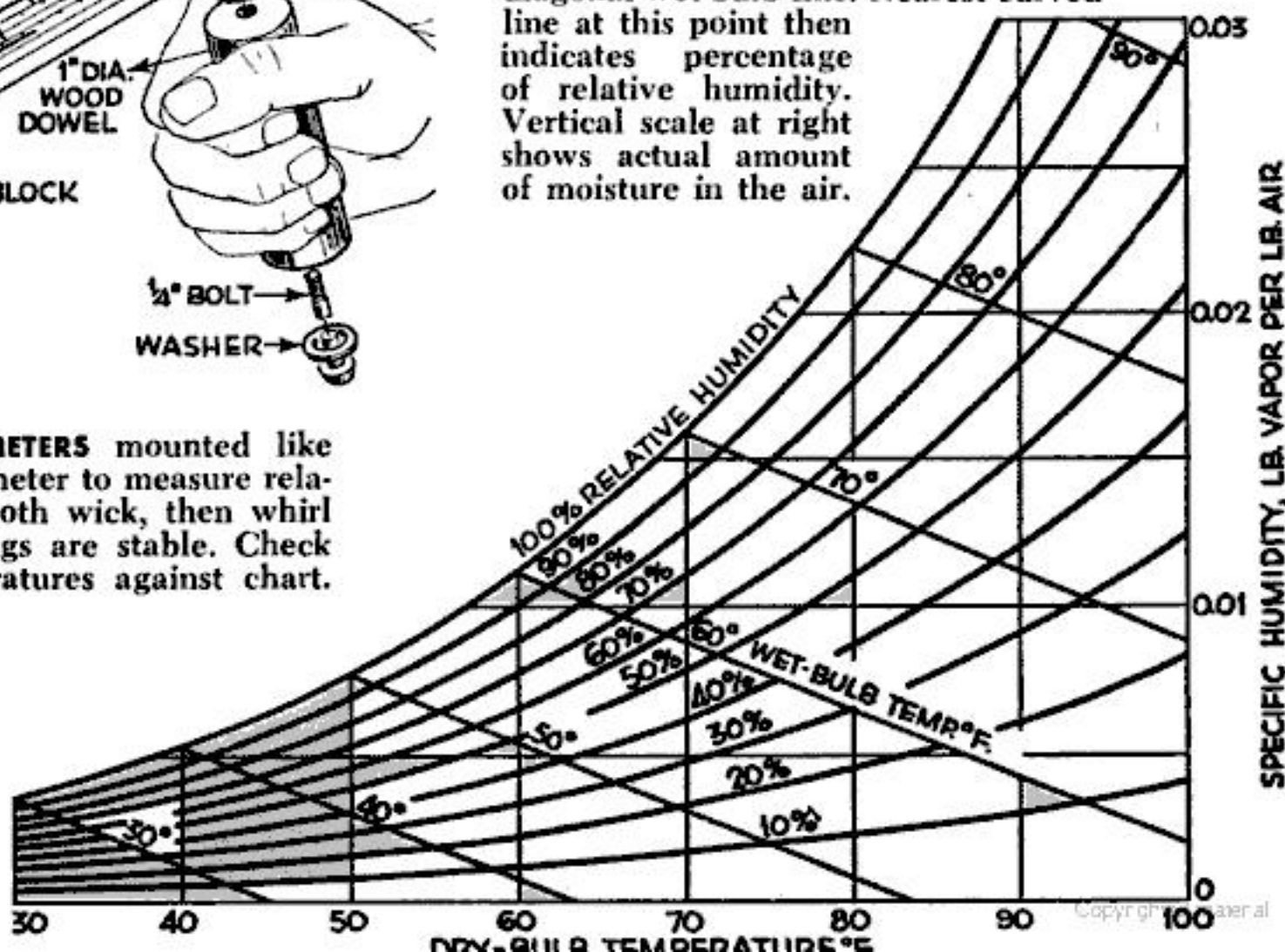
ADDED VAPOR BARRIER on inside of stud space is cure for new construction. It turns back moisture so that cold outer surfaces stay dry. Barrier for old wall can be painted on.

How to make a humidity tester to spot your problems



TWO MERCURY THERMOMETERS mounted like this make a sling psychrometer to measure relative humidity. Wet the cloth wick, then whirl thermometers until readings are stable. Check wet- and dry-bulb temperatures against chart.

CHART SHOWS RELATIVE HUMIDITY from wet- and dry-bulb temperature readings. Find dry-bulb temperature along horizontal base line and follow this up until it intersects appropriate diagonal wet-bulb line. Nearest curved line at this point then indicates percentage of relative humidity. Vertical scale at right shows actual amount of moisture in the air.



weather where sub-zero temperatures are brief. The primer-sealer can be applied over an existing wall finish if the paint coat is sound, or even over tight wallpaper.

Some companies offer a paint especially designed for moisture control. Glidden's Spred Vapor Barrier is one example. It's a latex-type primer-sealer made of nonoxidizing materials. You can apply it with a brush or roller. Such a primer-sealer is even more effective when the finish coats are also latex based.

Pittsburgh Paint's Speedhide Primer has a Pliolite base and can be used on asbestos cement or uncured plaster.

With all brush-on barriers, the important thing is to get thorough coverage. If there are gaps in the paint coat, you've wasted your time. You must be certain to seal the *entire* surface of all outer walls—behind radiators and other fixtures, inside closets and cupboards, and behind the back edges of shelves. This may mean stripping these walls of built-ins, but it's a question of doing the job right or forgetting the whole thing.

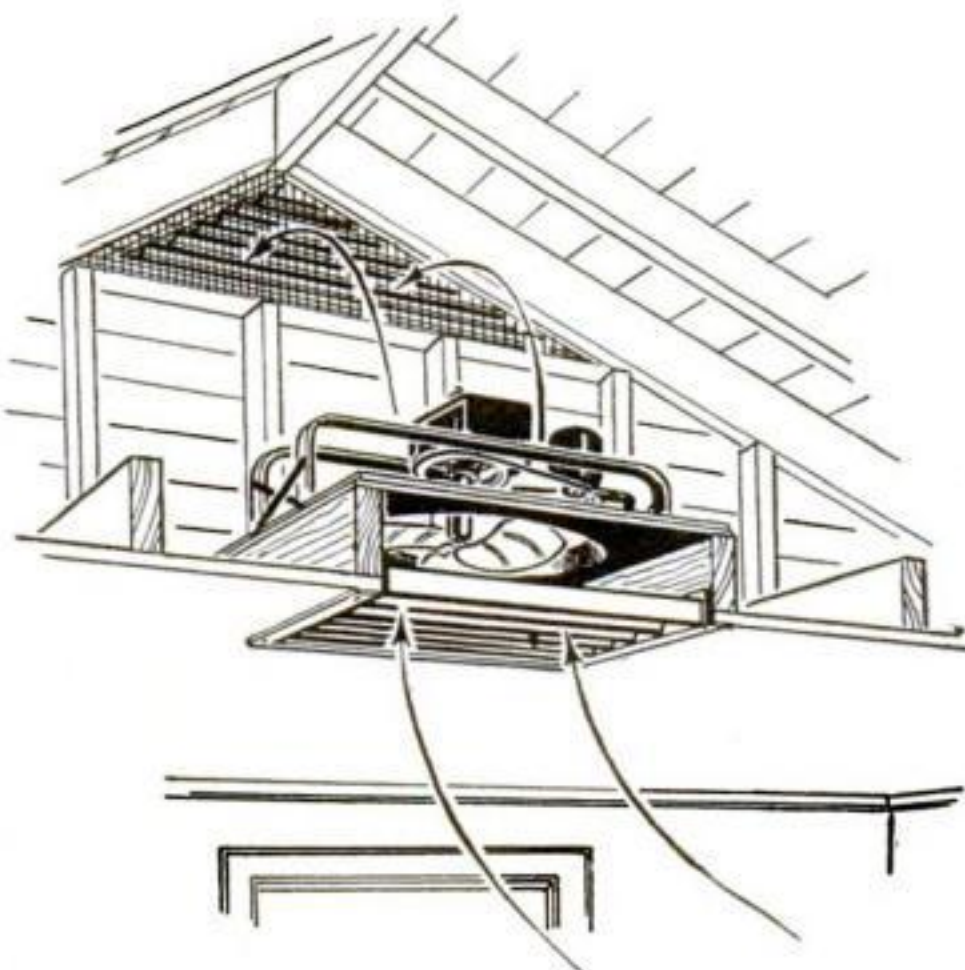
No vapor barrier can be perfect, so it's also important to provide a means of escape for the small amount of vapor that will still pass into the stud space. Building paper, sheathing, siding, and exterior paint should all be vapor-permeable so vapor won't accumulate and condense inside the wall.

Sealing the ceiling. Unoccupied attics can be a reservoir of moisture. As in walls, insulation at ceiling level keeps heat from reaching the roof. If there's no barrier, vapor will condense on the cold underside of the roof, on projecting nails, or between the roof sheathing and outer covering. During cold weather, ice or frost forms. At the first thaw, this melts and drips onto the ceiling, causing water stains or loose plaster.

If you already have insulation in the ceiling without a barrier, the simplest solution is to paint a barrier on the room side of the ceiling. The procedure is the same as for walls. Where there's no insulation, you may prefer to install a sheet barrier, or insulation with a built-in barrier. If you plan to use an attic for living space, then the barrier—either paint or sheet—should go on the inside of the dwarf walls and suspended ceiling so it surrounds the heated area. ■ ■



EXHAUST FANS in a kitchen or bathroom window get rid of water vapor at its source before it spreads through the house. If equipped with a humidistat, they'll work automatically.



CEILING FANS move moist air in a hurry, but are mainly for summer cooling. Never use them in winter when under-roof surfaces are cold enough to condense vapor before it is vented.

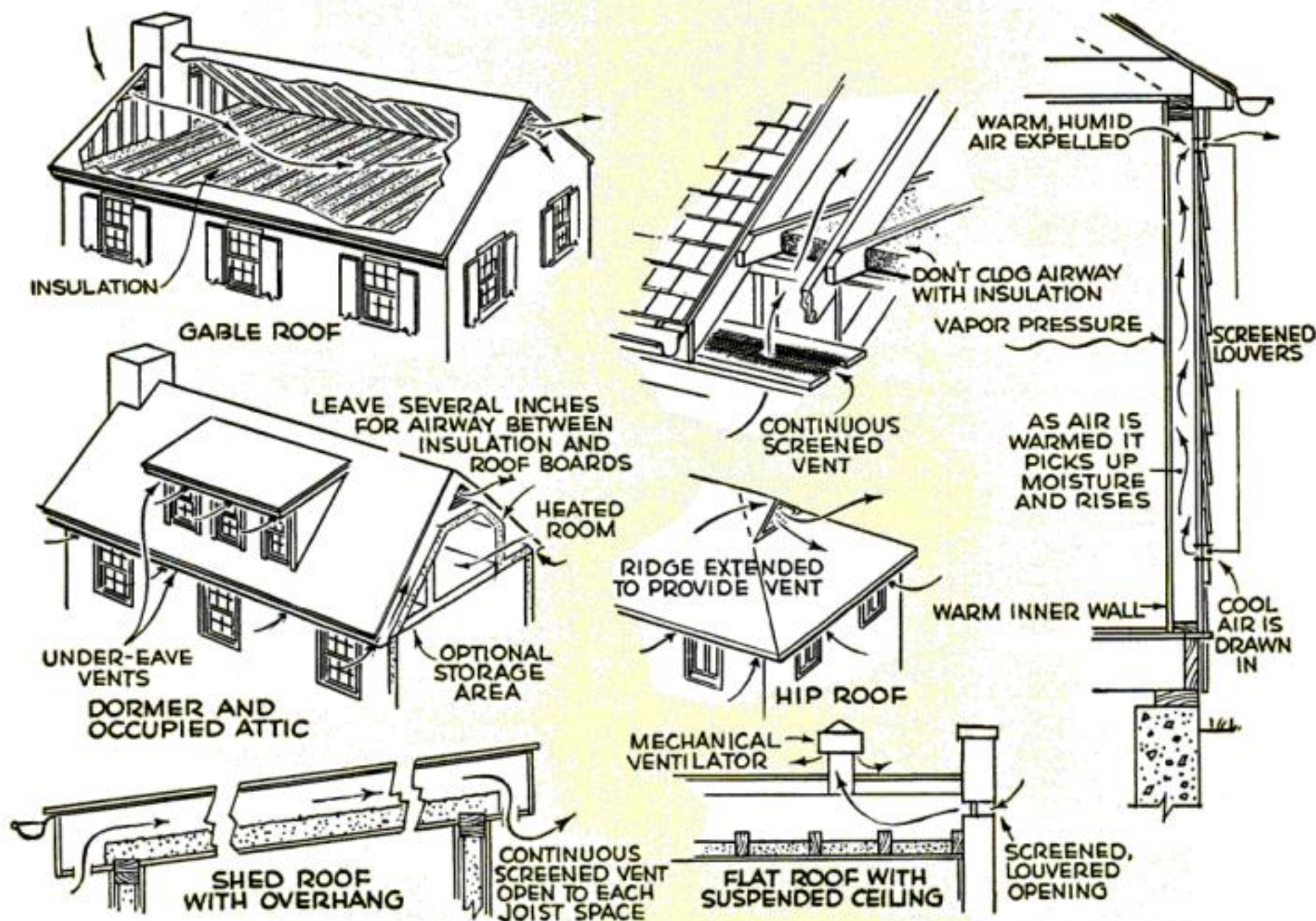
VENTILATE...

to remove moisture-laden air

How to coax a natural air flow through roof and wall spaces

MOVE DAMP AIR OUT OF ATTICS before condensation occurs. A combination of eave and gable vents is best, especially where attic is occupied. Under flat roofs, air flow may be too

sluggish unless a forced-draft vent is provided. Exterior wall venting (below, right) carries off vapor that seeps through inner wall. Each stud space must have vent top and bottom.



VENTILATION of today's homes cannot be a haphazard affair. Modern construction methods by which we seal a house tight—with insulation, vapor barriers, calking, and weatherstripping—have made ventilation a must to remove moisture-laden air before it can do damage.

The ventilation problem centers in the three major moisture-producing areas: the kitchen, the bathroom, and the laundry. But it also applies to the entire house, including attic and basement.

You ventilate by three major methods—with exhaust fans, with attic ventilating fans, and with vent openings built into the house itself.

A fan that provides a room air change every 15 or 20 minutes is a good means of removing vapor. But in a tight house, a fan can't function without a supply of fresh air. Some warm-air furnaces draw in fresh air through an outside vent. If your heating system lacks such an intake, you may have to leave a window or two open while the fan is on. In winter,

when outside humidity is relatively low, the fresh air is a special boon.

In the kitchen, a range-hood fan—intended for carrying off cooking odors—also exhausts steam. It is less effective, however, than a window or in-the-wall model that takes care of dishwashing moisture as well.

Individual fans in each moisture-producing area are your best bet. Vapor-laden air simplifies ventilation: You

living space to carry off excess vapor *before* it can move into cold areas and condense. Venting, on the other hand, is done to carry off moisture *already* in cold areas.

It's also important to distinguish between ventilating for cooling and ventilating to avoid condensation. A ceiling fan, installed to exhaust warm air in summer, may worsen a moisture problem in winter. It can load the attic with moisture and defeat the entire purpose of a ceiling vapor barrier. A cooling fan operated only in the summer is no problem.

Venting attics. To avoid condensation, the safest roof is one with a space beneath it you can vent to the outside. Insulation should be beneath this air space. Proper air circulation is very important here, particularly if there's no vapor barrier in the ceiling.

One formula for venting calls for a total net opening of one square foot for every 300 square feet of attic floor area. This should be split evenly between gable and eave vents, distributed for thorough cross-ventilation.

Gable louvers are most effective when there's a breeze, and must always be placed in line with prevailing wind. But often they won't do the job alone. Eave vents provide air movement independent of wind effect. Both are essential when the attic is taken over for living space and insulated. You should leave several inches of space between the insulation and the roof boards to serve as an air channel, vented at the eaves and gables.

"Net opening" means the actual air-flow area. If you install screens or louvers, you have to increase the overall opening size two to three times.

Too much attic ventilation may be as troublesome as too little. It can cool the top surface of insulation or attic flooring so much that moisture condenses before it has a chance to pass out the attic vents. Also, frost can form on the underside of attic floors laid over insulation. The solution to such problems is a vapor barrier below the insulation.

Crawl spaces. As with gables, vents in crawl spaces are often inadequate or improperly located to take advantage of prevailing winds. Some home owners close them up in winter or block them with shrubbery.

[Continued on page 180]

Good Ventilating Practices for Everyone

- In kitchen, bath, and laundry, even the simplest ventilation can help. Before tackling a steamy job, open a window a crack, top and bottom.

- To prevent the spread of water vapor through the house, keep the doors of these rooms closed until it dissipates.

- When single-glass windows frost or steam up in living or bedrooms, lower a top sash 1" on opposite sides of the house until the panes clear.

- When laundry is done in the basement, leave windows there open for a day afterwards.

- Vent moisture-producing appliances—dryers, gas stoves, heaters, and refrigerators—to the outside.

- Leave the fireplace flue open when not in use; the draft provides a ready exit for moist air.

don't have to move a great *volume* of air to get rid of moisture that's highly concentrated. With air indoors at 70 degrees and 30-percent relative humidity, you'd have to exhaust 14,000 cubic feet to get rid of one pint of water. That's a lot of air—and a great waste of heat. At 45-percent relative humidity, however, you need move only 4,000 cubic feet per pint—a 10-percent heat saving.

Ventilating and venting. You ventilate



a practical
solution to a
HUMIDITY
problem

DEHUMIDIFY...

to control moisture-laden air

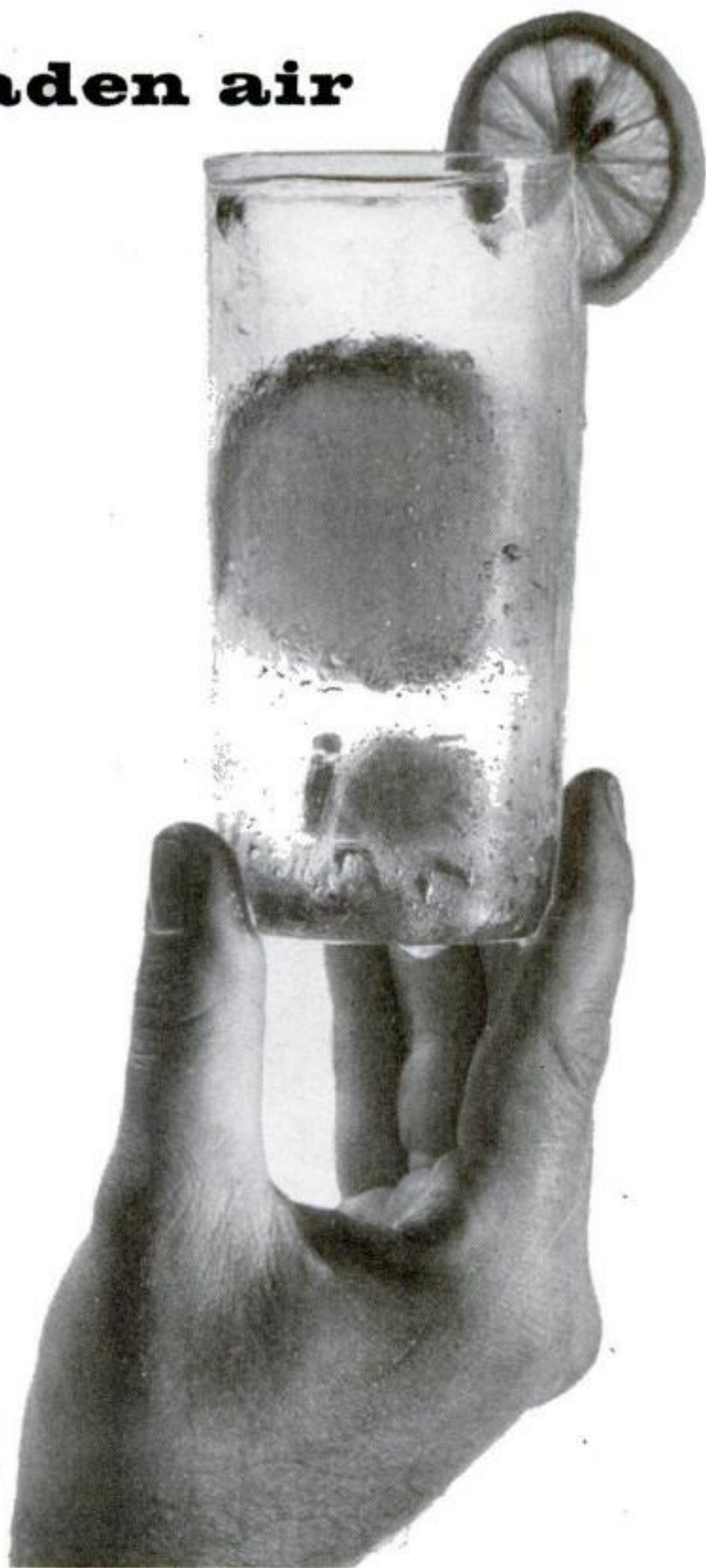
MIX yourself a tall, cool drink, keep your eye on the glass, and you can watch how a dehumidifier works.

Moisture in the air condenses into drops of water on the cold surface of the glass. That's all you need for a dehumidifier: a larger cold surface to replace the glass and a way to keep room air moving past it. If you reheat the chilled air at the same time, you also make it relatively drier by increasing its capacity to hold moisture.

Most dehumidifiers now on the market work this way. They function like a refrigerator. Warm, moist air is blown past a chilled coil. The moisture in the air condenses on the coil and drips into a pan. The air is then reheated and sent back into the room.

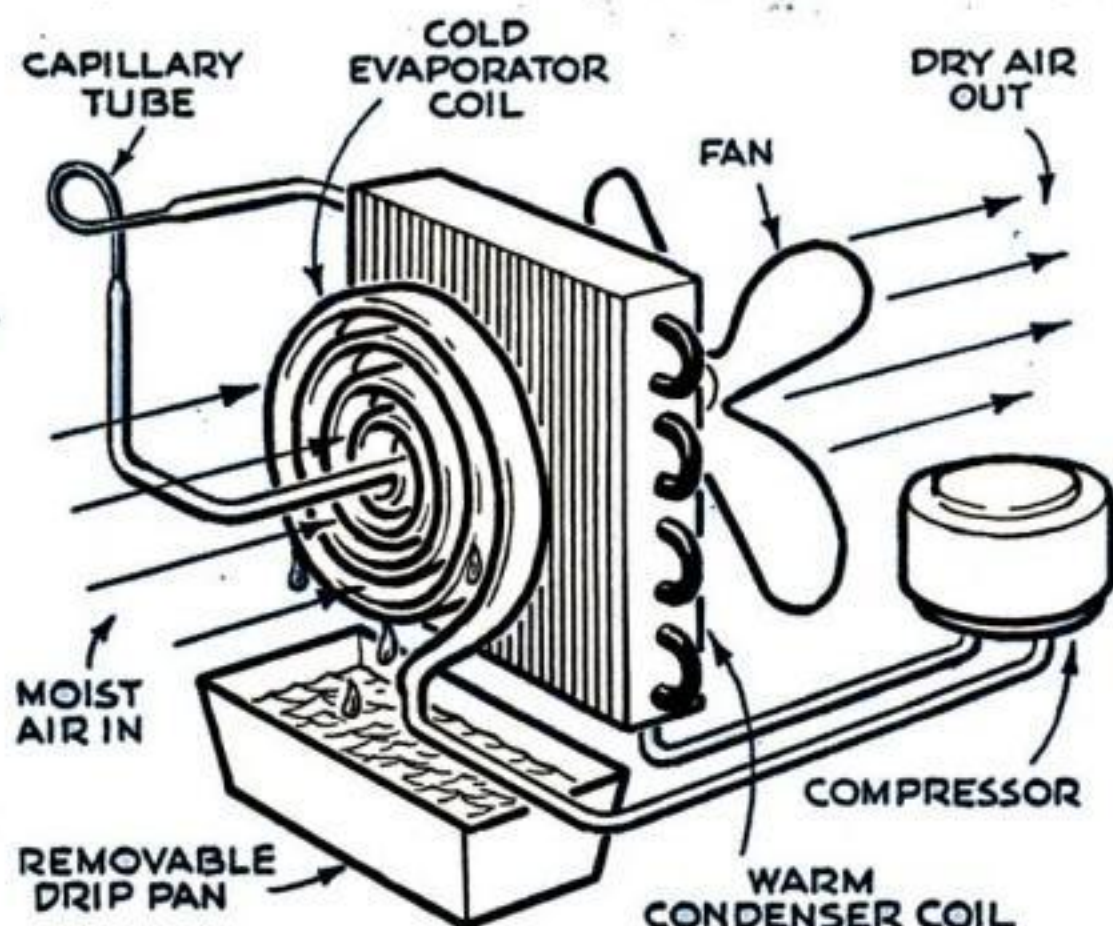
A few less common dehumidifiers work on the adsorption principle. Moist air is drawn through a chemical drying agent that sops up moisture like a sponge. The air isn't cooled so there's no need to reheat it. When the drying agent has collected all the moisture it can hold, an electric heater dries it for re-use.

Which is better? Adsorption-type dehumidifiers re-



CONTINUED

Here's how the two kinds of dehumidifiers work



IN REFRIGERANT-TYPE DEHUMIDIFIER, moist room air is drawn through a cold evaporator coil, chilled by expanding gas inside. Moisture condenses on the coil and drips into the pan. The cool, dry air is then reheated by passing through the warm condenser coil where the refrigerant

gas is condensed back into a liquid. A compressor keeps the system pressurized and a capillary tube reduces pressure for evaporation of the gas, just as in a refrigerator. Mobile, TV-size model at left rolls on casters, has removable drip pan slung underneath.

quire a permanent outdoor vent, like a clothes dryer—they're not portable. They cost more than the others, too, ranging from \$145 without a humidistat up to \$175 with one.

Refrigerant-type dehumidifiers start as

low as \$80, with top-capacity, humidistat-equipped models at \$130 to \$150. Most of these are compact, TV-size units you can carry from room to room. The water they collect is removed by emptying the drip pan once a day or by running a hose

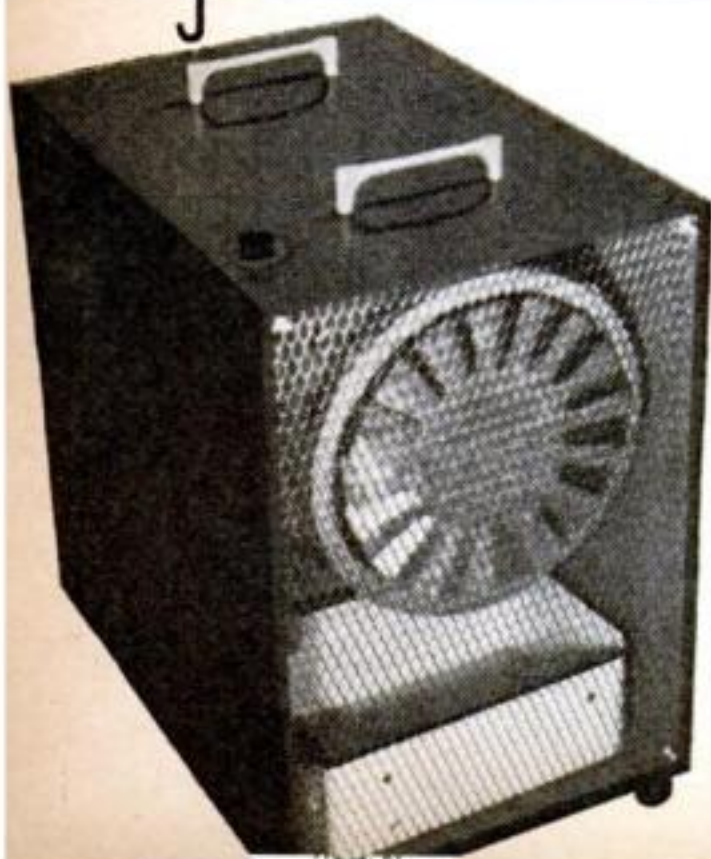
a practical
solution to a
HUMIDITY
problem

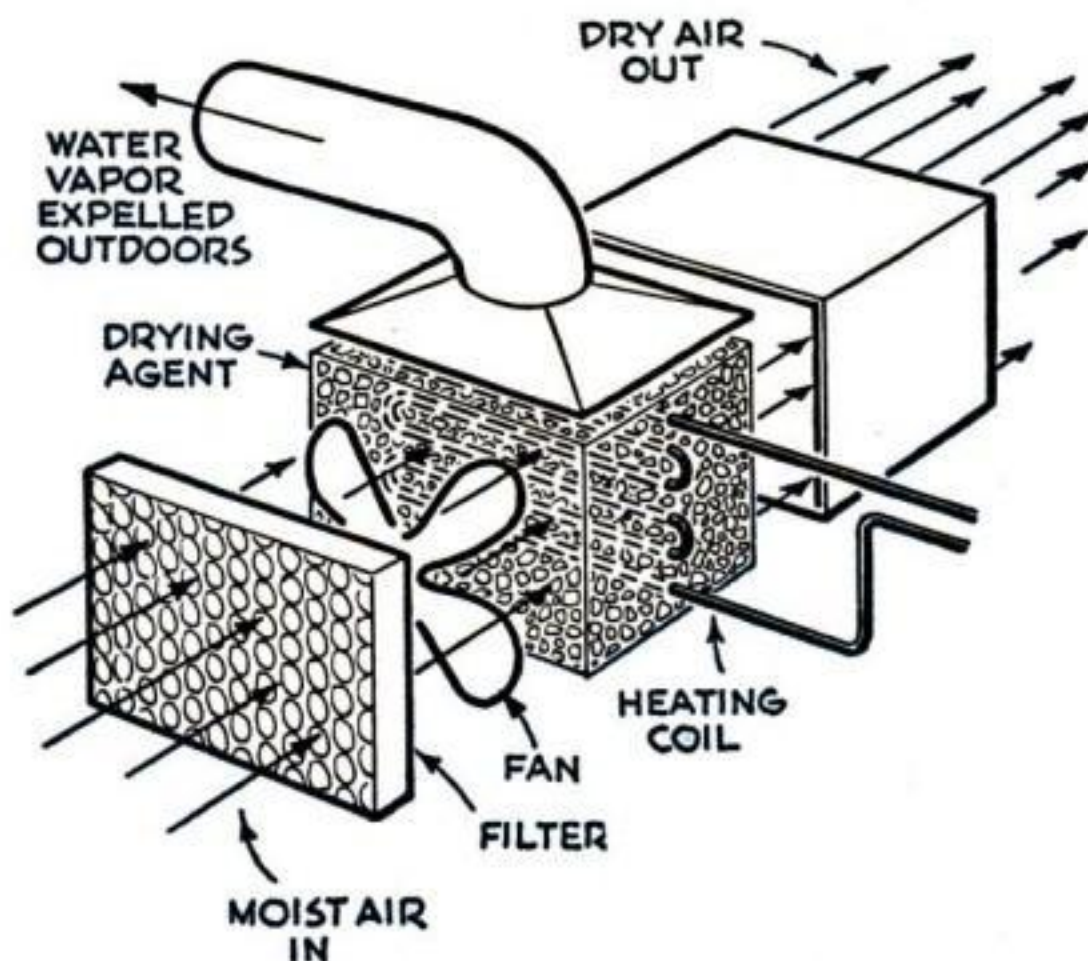
Build Your Own Dehumidifier

MOST of the parts you need to make a first-rate home dehumidifier can be salvaged from an old household refrigerator. For less than half the price you'd pay for a store-bought one, you can build your own moisture-collecting machine—and this includes buying a used box, paying a refrigeration mechanic to charge your finished machine, and the price of an automatic humidistat.

Obviously, you can do a limited amount of dehumidifying simply by taking the door off an old refrigerator and using an electric fan to blow air past the freezing unit. But unless the room air is quite warm, you'll soon find the coils caked solid with ice.

This brings us to the only basic change needed to





IN ADSORPTION-TYPE DEHUMIDIFIER, moist air is drawn through a chemical drying agent, usually silica gel or activated alumina. This sops up moisture like a sponge. When the chemical is saturated, a time switch automatically turns on an electric heating element to dry it out.

from the pan to a nearby plumbing drain.

Adsorption-type dehumidifiers are better under some conditions for a curious reason: Refrigerant-type dehumidifiers work fine on very hot, humid days, but drop off fast in efficiency as the tempera-

Moisture released by the heating element is expelled outdoors through a vent, and the chemical is ready for re-use. Whatever the type, a dehumidifier is an ideal addition to a prized shop, to keep tools free of rust. The dehumidifier above is refrigerant type.

ture decreases. At 90 degrees, a typical machine will remove about three gallons of moisture from the air a day; at 80 degrees, about two gallons; and at 70 degrees, only about two quarts. The refig-

[Continued on page 176]



convert the refrigerator machinery for a dehumidifier: The capillary tube must be altered to allow the evaporator (cooling coils) to operate at a higher temperature. The evaporator should be cold enough to cool air below its dew point but never cold enough to freeze the condensed water.

Best and easiest solution is to buy a capillary tube designed for a humidifier with the same size compressor. Explain your problem to your refrigerator mechanic. If he doesn't have the right one and can't get it for you, the next best thing is to cut off the existing "cap" tube. Usually, taking about 60 percent off the length is about right.

If you have to buy a used refrigerator, choose one that runs quietly. The freezing coil should feel cooler soon after starting.

Special handling tips

DISMEMBERED refrigerators are fussy and need special handling to prevent trouble after reassembly. Here are the tips you need to know:

- Bleed not-quite-all the gas out of the unit, and do it slowly, lest compressor oil come out too. Work outdoors or where there's lots of ventilation.

- Handle compressors gently. Never turn them upside down, and don't run them empty.

- Remount condenser coils in their original orientation. The same goes for strainers and accumulators.

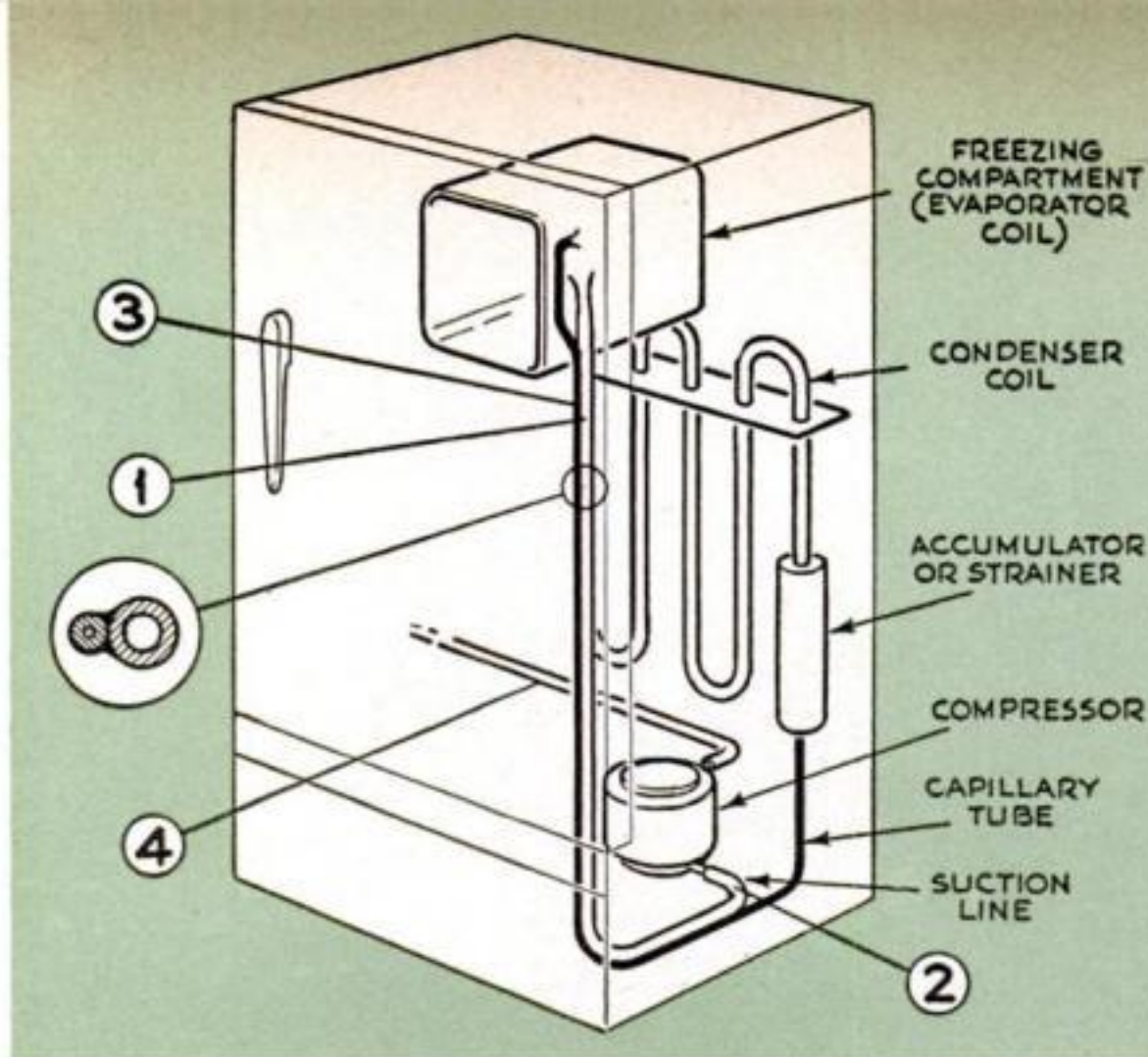
- **Keep all tubing** absolutely free of moisture and dirt.

- Provide as much ventilation for the compressor and condenser coil as they had in the old refrigerator.

How to discharge a refrigerator

BLEED GAS from the system in proper sequence to prevent damage to compressor. 1) Nick suction line close to freezing compartment to release gas slowly. 2) When hiss is barely audible, cut suction line near compressor. Crimp tube on compressor side to seal it. 3) Cut capillary tube; crimp the strainer side. 4) Cut line to condenser coil; crimp the compressor side.

For safety, remove door from box before discarding it.



Be sure the compressor label is marked "F-12," which indicates it is charged with nontoxic Freon gas. Try to find a compressor rated at 1/5 hp. or more, but even with a 1/8-hp. job you'll be able to match the performance of many brand-name dehumidifiers.

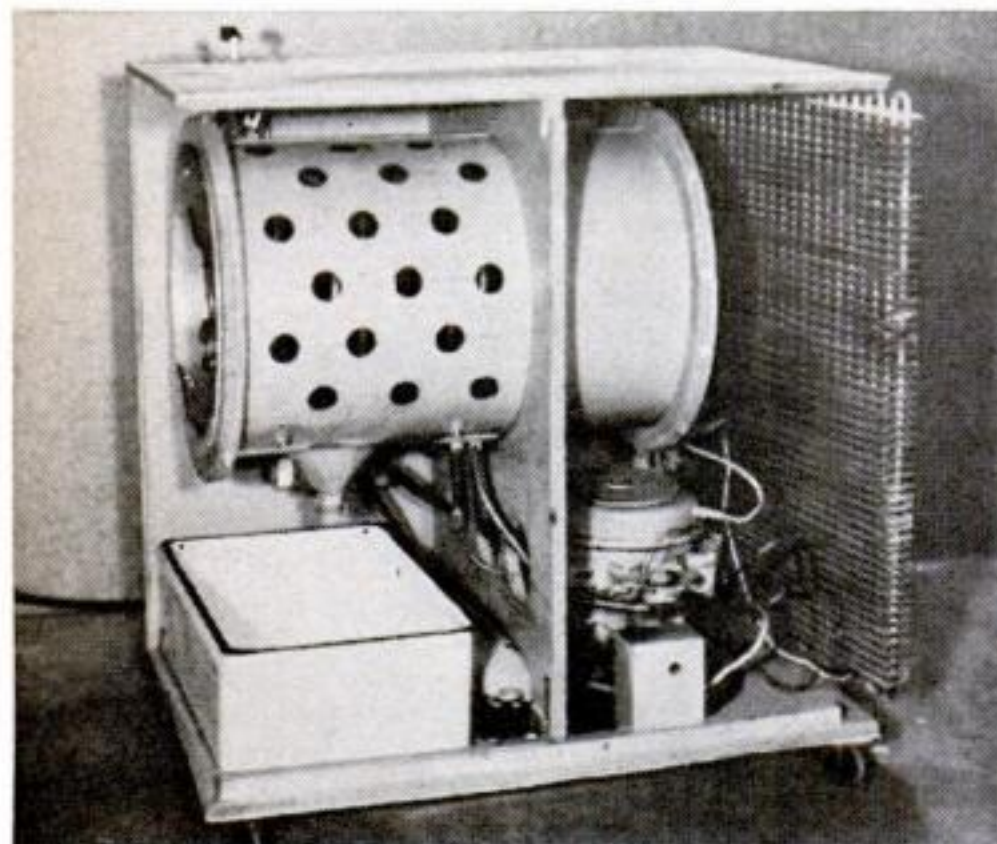
The exact size and shape of your finished machine is not too important. You can use one of the ideas shown in the sketches or dream up your own. Here are the basic facts you'll need to know:

- A fan should move air first past the evaporator coil, then the condenser.

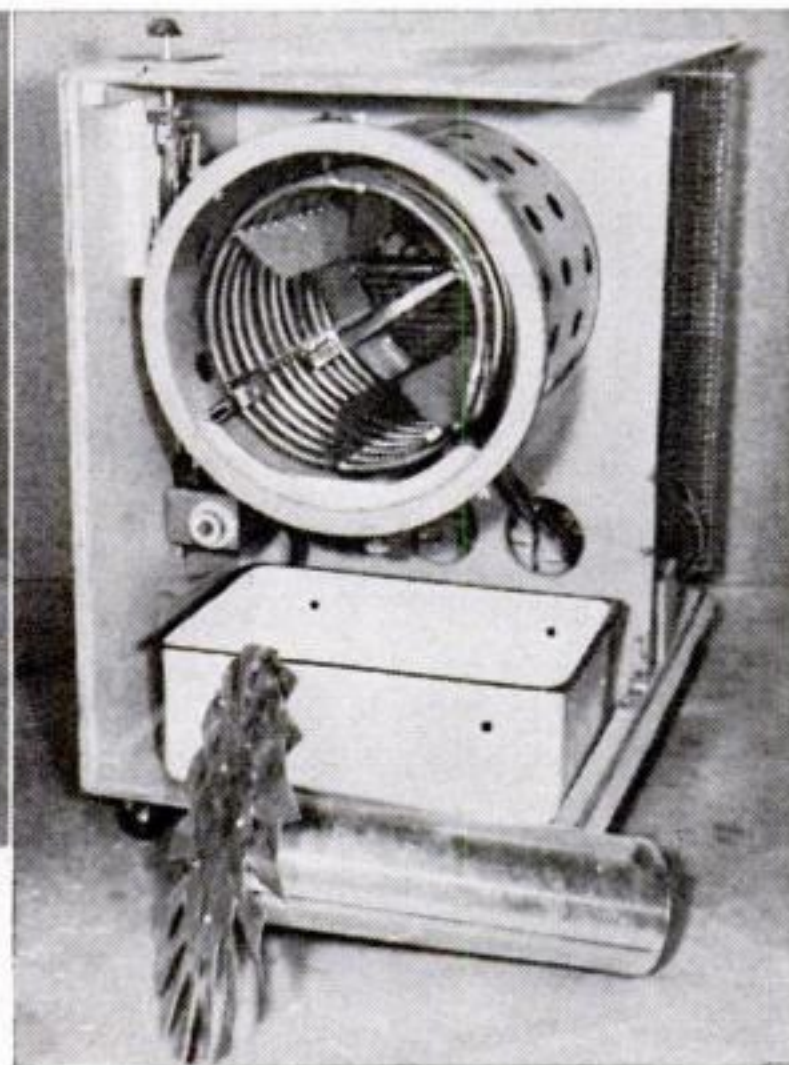
- Replacing the freezing unit with an evaporator coil you can make will increase the area of cold surface and thus increase moisture-removal ability.

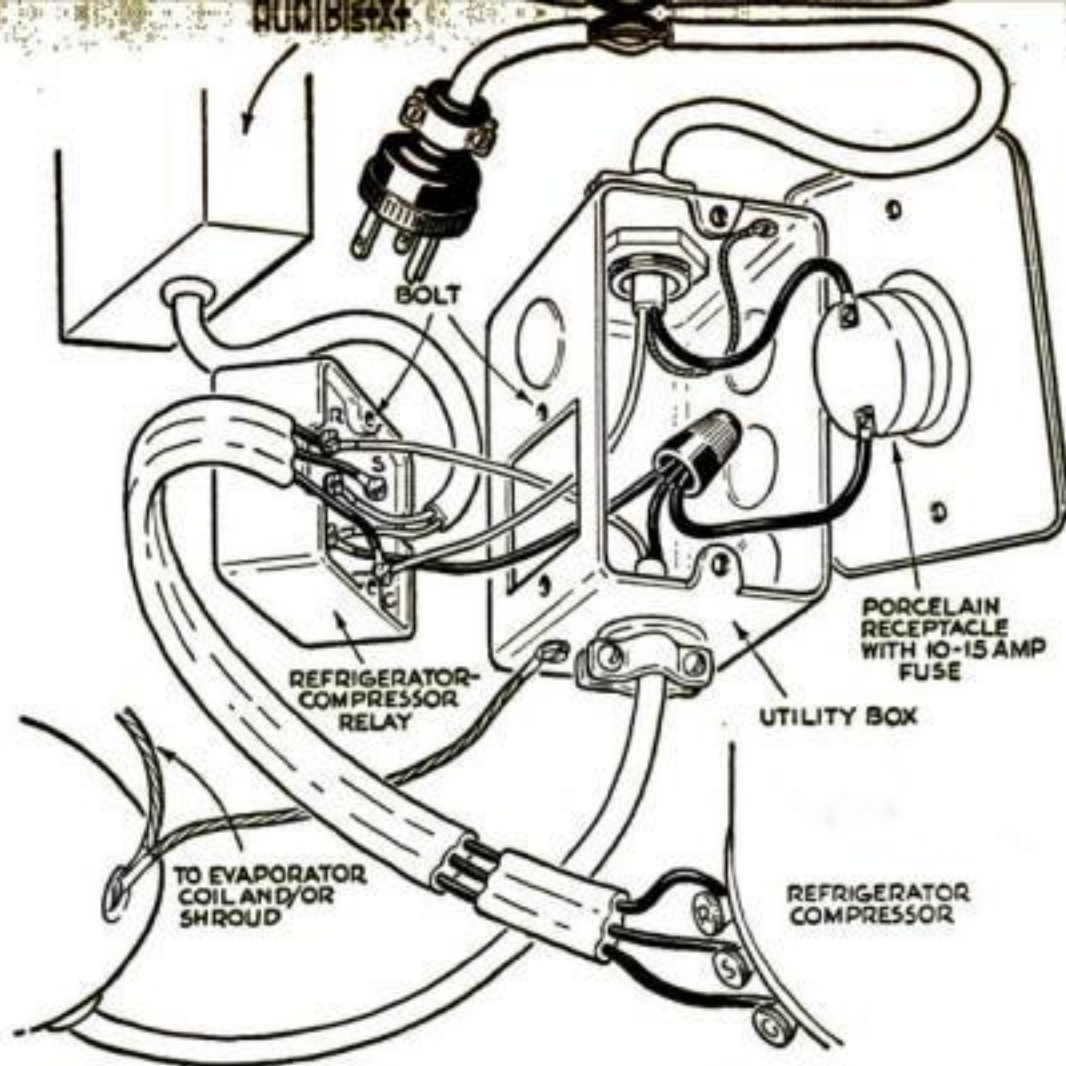
- Use 3/8" copper tubing to make a new coil. Volume should match that of the existing one. Fill the old coil with water and measure the amount it takes. Figure 2.43 feet of tubing for each fluid ounce of water the old coil held.

CONTINUED



THE INSIDES of one homemade dehumidifier are shown in these two views. Cabinet is 1/2" exterior plywood, sealed to prevent moisture damage. Center tube with baffle (on floor at right) fits in center of coil to direct air flow around the coil.

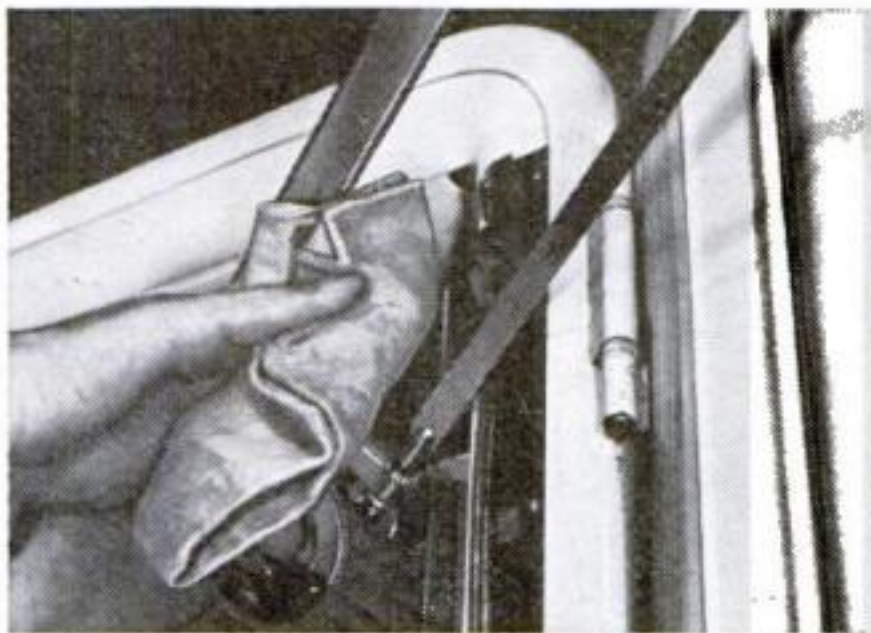




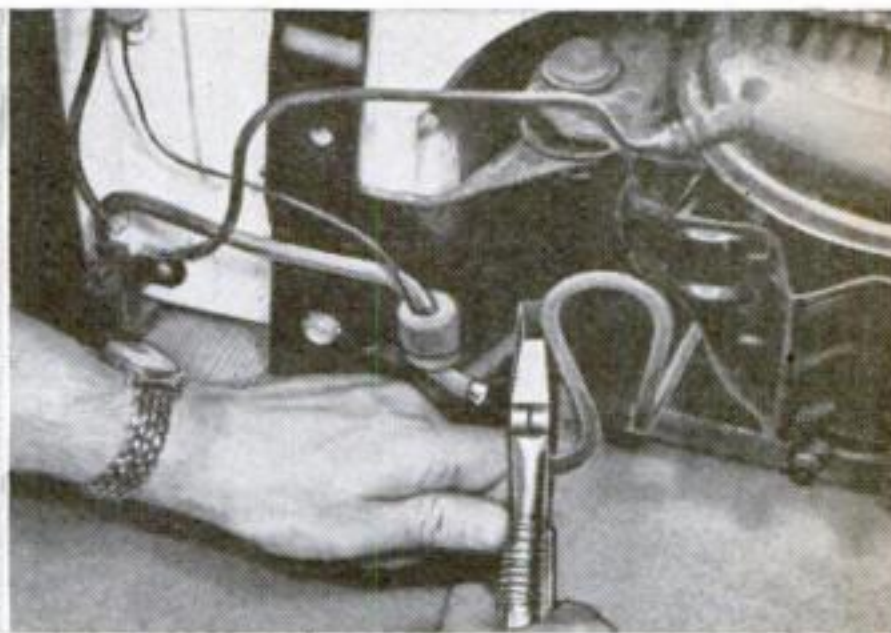
Making the connections

SAFE WIRING for your dehumidifier means adding a junction box to existing refrigerator wiring system. Use three-conductor wire, grounding-type plug for connecting cord. Strap metal parts together and ground through green wire in cord. Connect fuse in series with black (hot) wire. Connect humidistat in place of refrigerator thermostat. White wire (neutral) should be uninterrupted throughout.

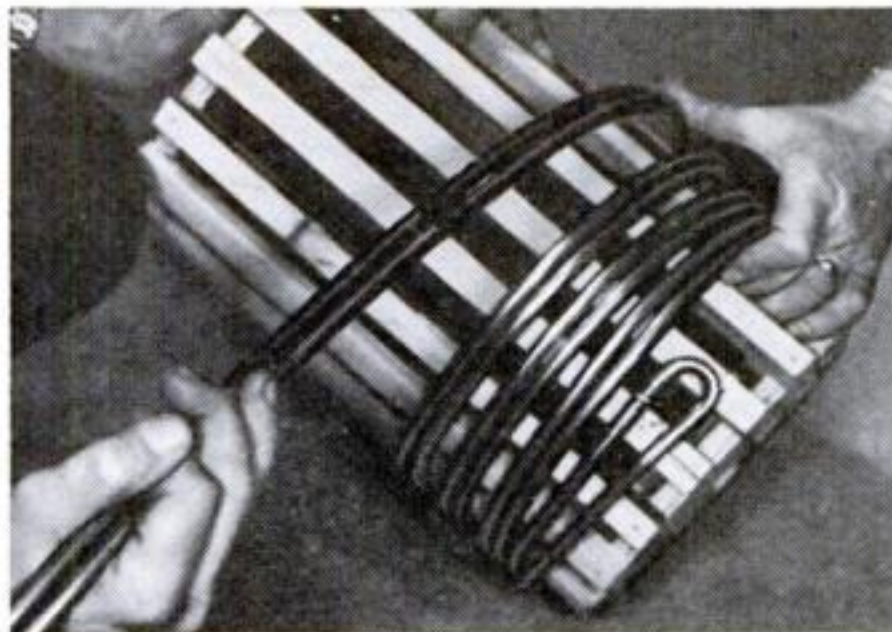
Helpful hints for getting started on your dehumidifier



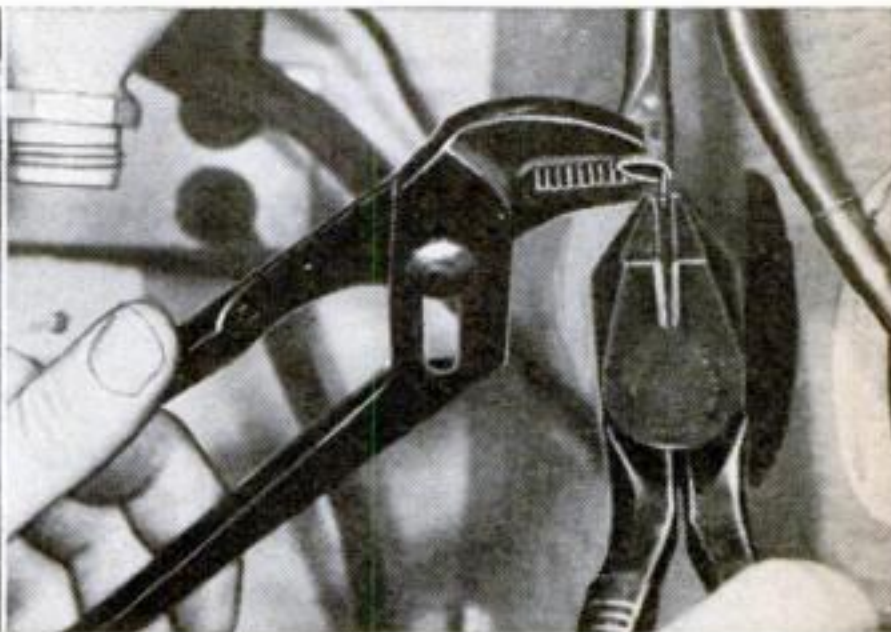
NICK SUCTION LINE with a saw or file to start releasing the gas. A cloth held over the opening will muffle the "whoosh" of escaping gas.



PINCH OFF THE TUBES immediately after cutting them to keep moisture and foreign matter from getting into the refrigeration system.

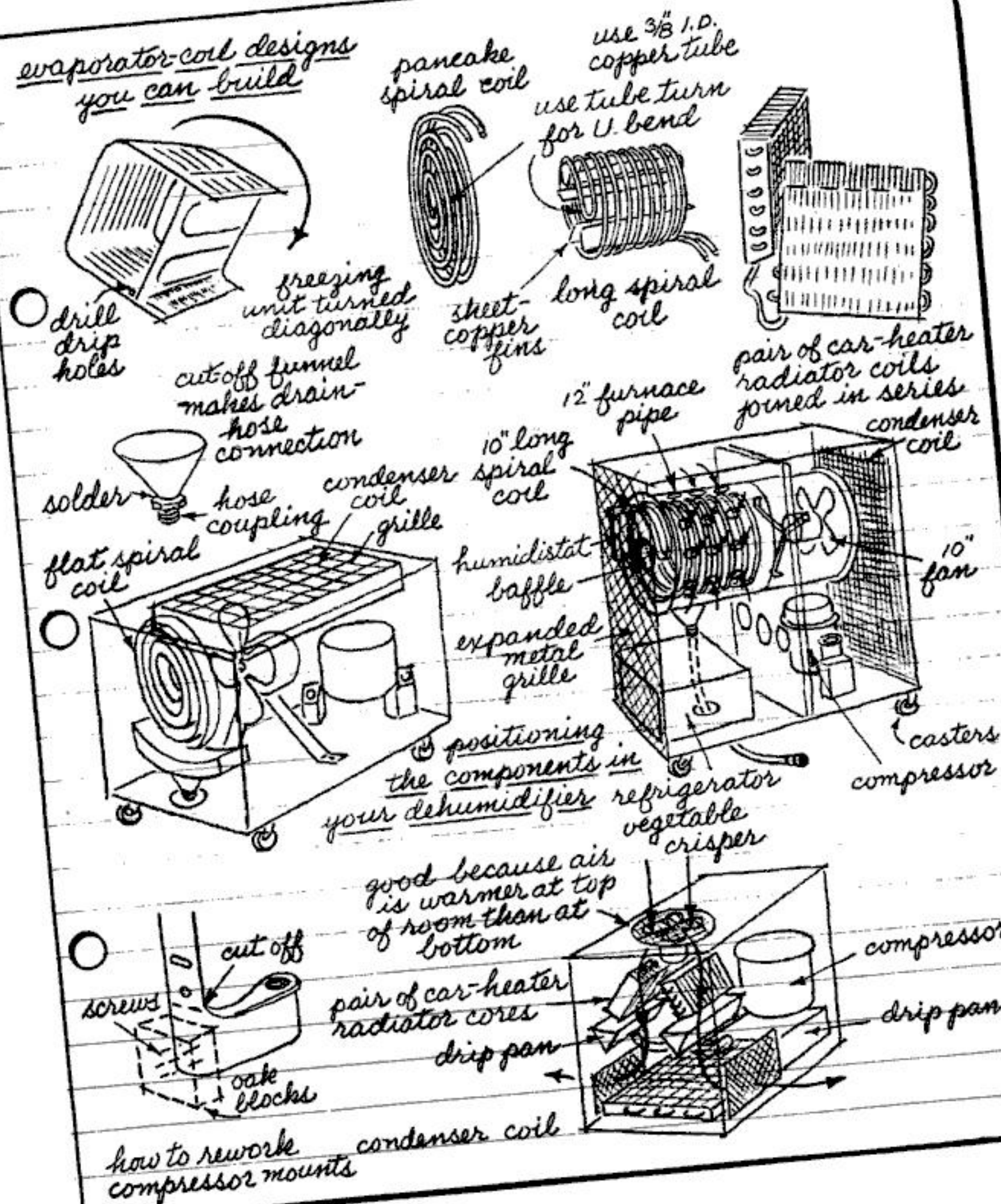


BUILD A COIL FORM to aid winding job. Soft copper tubing is easily worked by hand. Center bend is made with a sweated-on "tube turn."



MATCH THE TUBES by mashing large evaporator tube over a nail of the same size as the outside diameter of the tiny capillary tube.

evaporator-coil designs
you can build



● Carefully sweat-solder all joints in the tubing.

● Don't start the compressor until you've had a refrigeration serviceman "blow down" the system and recharge it. He'll have to braze a stub tube into one of the lines to do this. You may save time and trouble if you ask his advice before the project is too far along.

● Adding a humidistat will make operation completely automatic. (Bendix-Frieze, Model 80-1, is available from Montgomery Ward for about \$10.)

● If the coil either freezes up or doesn't get cold enough, ask your serviceman to remove or add a little gas as needed to make your dehumidifier operate in the proper temperature range. ■ ■



HUMIDIFY...

when dry air is the problem

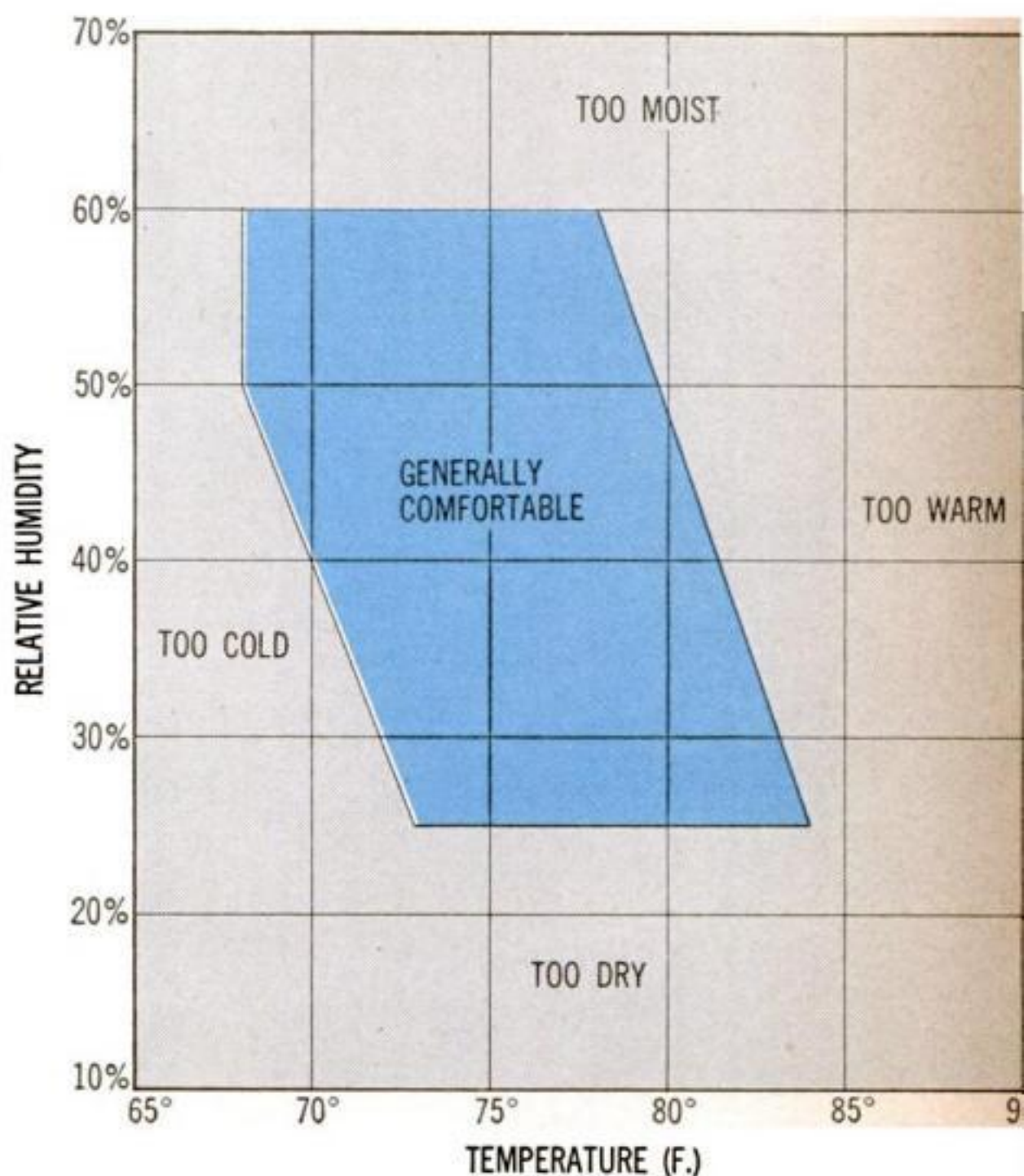
IN WINTER, the percentage of moisture in the atmosphere of your home directly affects your fuel bill, your comfort, and your health.

The relative humidity in winter-heated homes *averages* between 10 and 15 percent. And it can drop as low as three percent when the outside temperature hits zero and you maintain the inside temperature at 70. Nature never intended air to be this dry. Even Death Valley has a relative humidity of 23 percent.

When you shiver, and push up the thermostat, your need actually may be a higher humidity, not a higher temperature. With the right humidity, you may be comfortable at temperatures three to eight degrees lower than the reading required for a relative humidity of 10 to 15 percent.

It's a money saver. This fact could mean a saving of one-tenth of your fuel bill over the heating year. Each degree of increase over 70 degrees adds three percent to heating costs.

There's nothing new about putting moisture into heated air. When gravity hot-air furnaces were the most common central-heating system, a humidifier came as part of the package—usually just a water pan in the bonnet. When one-



**Why
more moisture
lowers your
heating bill**

MOIST AIR makes lower temperatures comfortable (see chart) and lets you get by on less heat. Ideal humidity is a matter of personal preference, and the shaded area indicates how wide the general comfort range is. But most people will be comfortable at 70 degrees—if the humidity is 40 percent. Nobody's happy when humidity is below 25-percent or above 60.

CONTINUED

Humidifiers work in many ways. Here are the five basic types

pipe steam heat developed, the humidifier was still a water pan—set or hung on the radiator.

Recognizing several years ago that the pan method was obsolete, manufacturers extended the evaporation surface by adding plate wicks. Recently, however, humidification has taken giant strides.

Modern humidifiers are available for every heating system. When you can't connect one to the furnace, you buy a separate model that looks like a hi-fi console—or a portable you can carry from room to room.

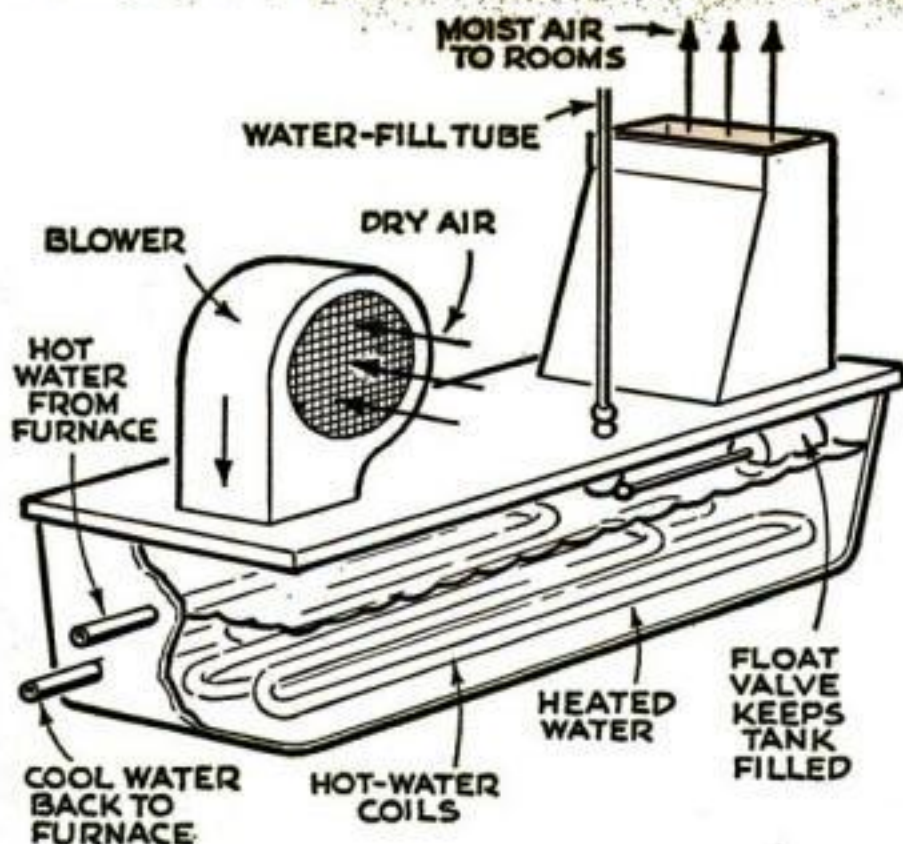
Plate-type units depend on natural evaporation. Their cost is modest—\$15 to \$20—but so is their capacity. Also, their porous plates clog up and must be replaced once or twice each season.

Most models come with only four or five plates, although a six-room house may actually need 10 to 15. Some units have space for extra plates—a feature to check. More efficient models have an electric heating element to warm the water and speed evaporation.

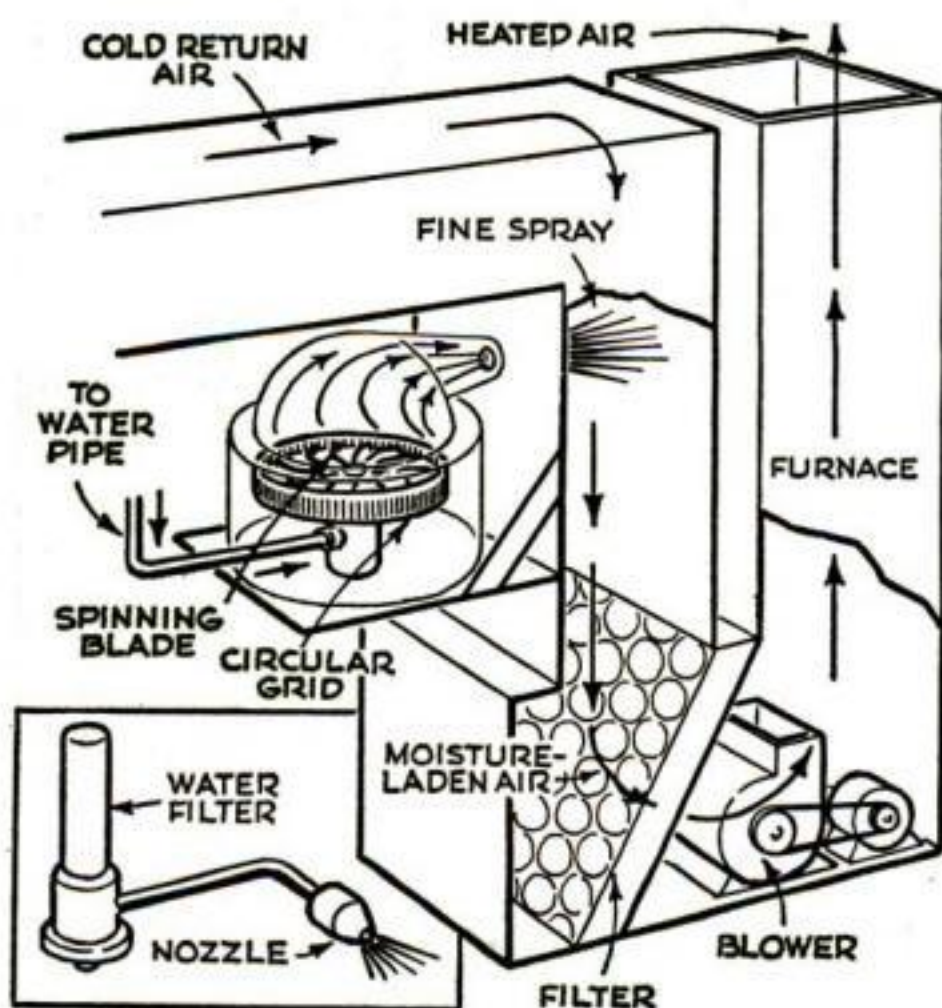
Force-type humidifiers boost moisture output with a power assist. Atomizers shatter water into a fine mist and spray it into the air stream. Vaporizers boil water into the air by means of an im-



DRY AIR IS A THREAT to furniture and rugs. A small, portable humidifier like this one can keep your piano in tune—and humidify the whole house—if it has adequate capacity.

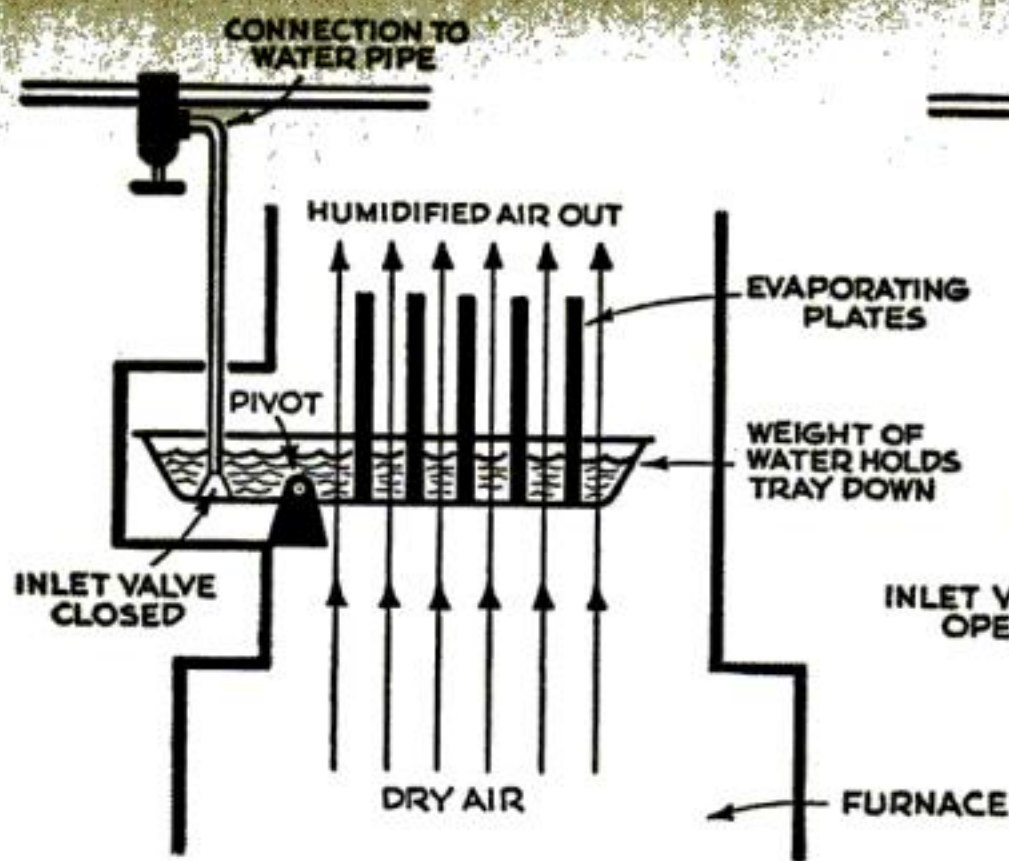


HOT WATER IS VAPORIZED to provide moisture in this type. The water is heated by hot-water pipes from the furnace or by electric coils. A fan then blows dry air over the water to pick up vapor. The unit can be used either in warm-air heating ducts or with its own ducts.



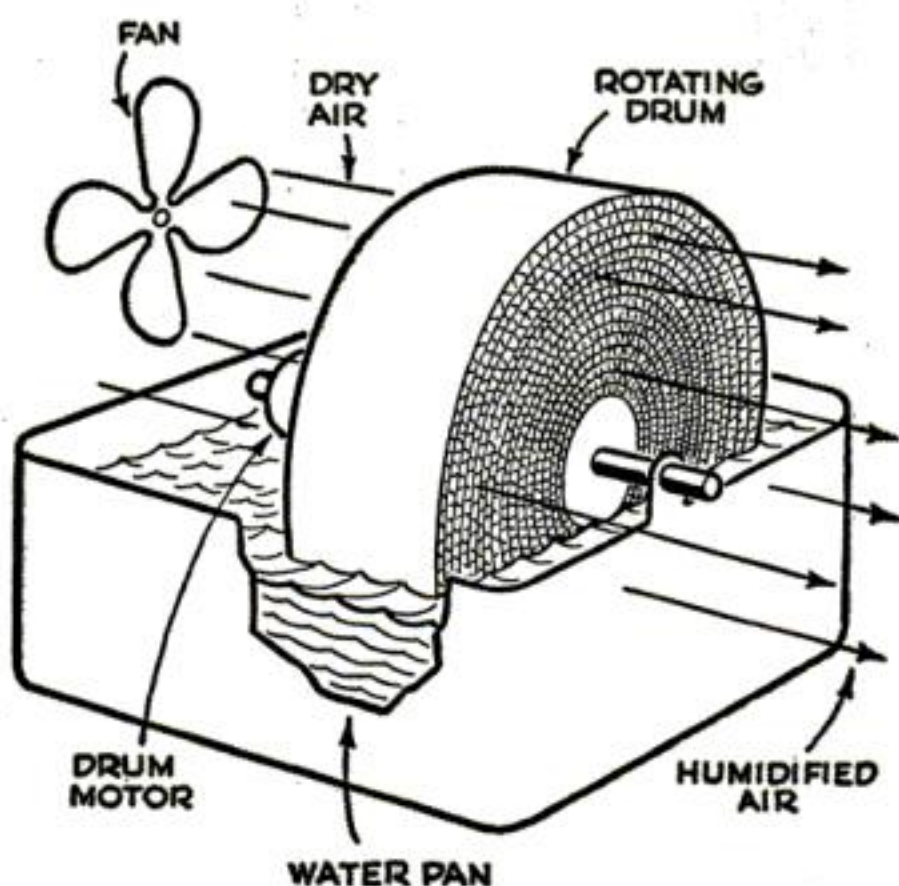
WATER IS SPRAYED INTO THE AIR in two types of atomizing humidifiers—either by spinning it into a fine mist, as at top, or by jetting it from a nozzle, as at bottom. Many atomizers mount in the cold-return duct so mineral deposits are taken out of the water by the furnace filter.

mersed heating element. In another method, evaporation is stimulated by forcing air through a water-soaked pad or drum. The advantages of forced humidification include no cleaning or replacement of filter pads, and a higher moisture output that does not depend on natural evaporation alone.

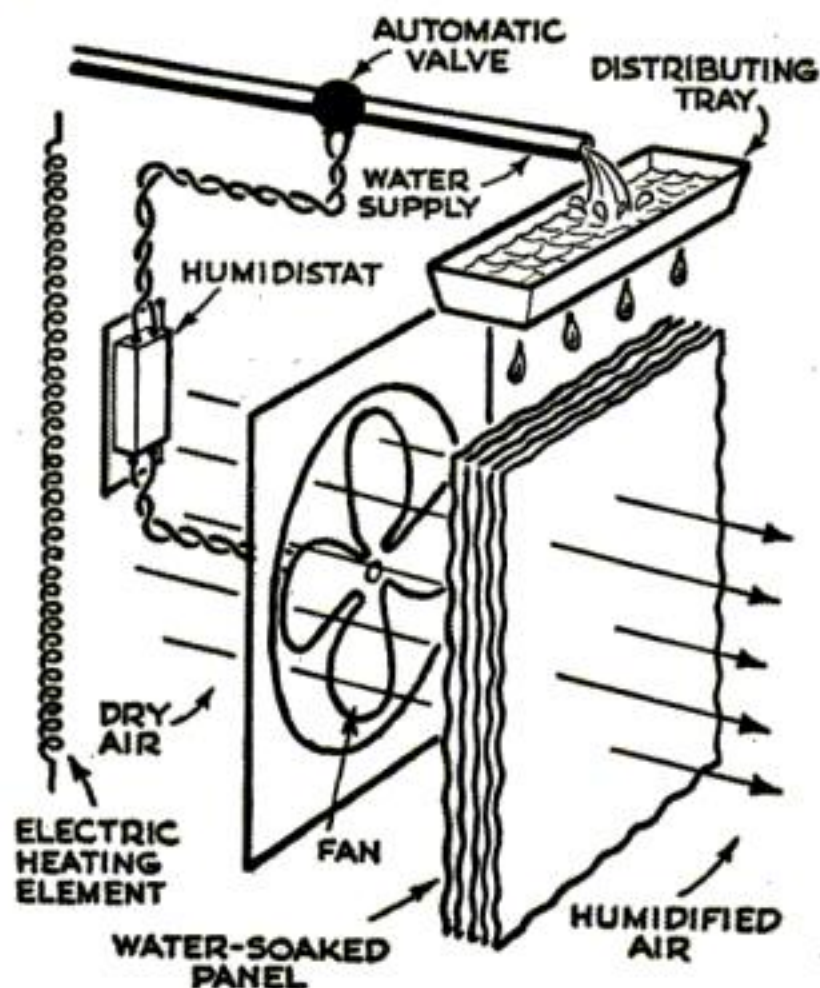


IN PLATE-TYPE HUMIDIFIER, porous, wicklike plates are kept wet in a tray of water. Hot, dry air from the furnace picks up moisture from the plates and disperses it through the heating ducts. Plates mount above furnace, require only one connection to cold-water line. Various auto-

matic valves keep the tray filled. In the type shown, the tray is pivoted and counterweighted so it tilts up as the weight of water on it lessens. This opens the inlet valve, allowing water to flow in until the tray tilts back down and closes the valve. Early models were hand-filled.



A WATER-SOAKED DRUM supplies moisture in this forced-evaporation model. The porous drum rotates slowly, picking up water from a pan as a fan forces dry air through it. It can be used in warm-air heating ducts, with separate ducts, or without ducts as a portable unit.



AIR PICKS UP MOISTURE from a water-soaked panel in another type of evaporator. Panel is kept wet by dripping water from above. An electric heating element warms the air to compensate for the cooling effect of evaporation. Both portable and furnace versions are made.

How much moisture do you need? The amount may surprise you. To make up the difference between average winter-time humidity (10 to 15 percent) and the recommended level of 35 to 40 percent, a humidifier must put out a minimum of a gallon of water per room per day—or six gallons for a six-room house.

Even this may not be enough. On a cold day, a six-room house may need as much as a gallon of water an hour. That amounts to emptying a bathtubful of water into your house air every day. Some machines are up to this; many aren't.

[Continued on page 166]

HOMEMADE

a practical
solution to a
HUMIDITY
problem

Humidifier for a Warm-Air Heating System

ANY home heated with forced hot air could use this homemade humidifier. It works automatically. A humidistat controls it.

Here's how: When dryness shrinks a human-hair element in the humidistat, the instrument trips a switch, energizing a relay. Next time the furnace goes on, a heating element boils water in a shallow pan enclosed in a chamber connected to the hot-air ducts.

Hot air drawn across the steaming pan picks up vapor and carries it into the heating system. When sufficient vapor has been distributed throughout the house, the hair control relaxes, opening a switch and shutting off the humidifier.

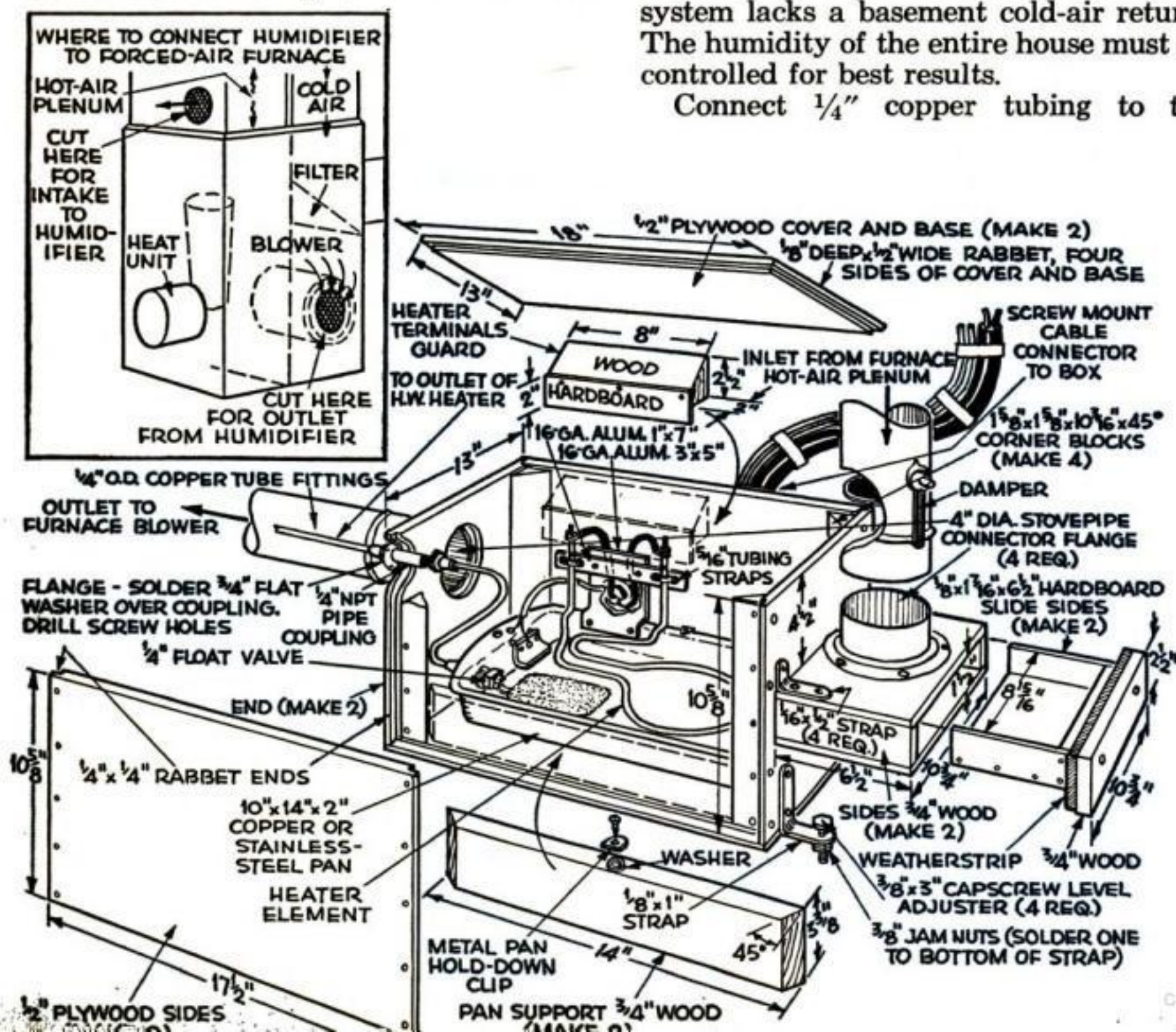
The unit will put out a maximum of 12 gallons of water a day.

The works are located in a box made of exterior plywood. Assemble the joints with waterproof glue.

Place the box in a location that will permit short runs of stovepipe from the hot-air plenum and blower housing of the heater. Level the box on its four adjustable legs, and connect it to the furnace with 4" stovepipe and fittings as needed. A typical installation is shown in the photo on the facing page.

A damper on the intake pipe and a sliding door on the humidity chamber allow the intake to be opened slightly to draw in air from the basement if your system lacks a basement cold-air return. The humidity of the entire house must be controlled for best results.

Connect $\frac{1}{4}$ " copper tubing to the



outlet side of the hot-water heater and run it to the stainless-steel vaporizer pan inside the box. Note that the pan is suspended by two $3\frac{3}{8}$ " cleats at each side to raise its bottom off the wood. Install the float valve in the corner of the pan.

The valve shown is a \$3 Aqua-Flow Humidifier Valve for a wick-type furnace humidifier. You can buy it at some hardware stores, or from a heating contractor. Connect a short length of $\frac{1}{4}$ " tubing to the valve, and fit a coupling to the tube where it emerges from the box. Solder a large washer over the coupling to serve as a mounting flange. Join the tubing from the heater to this coupling. A shutoff valve should be installed at the heater outlet.

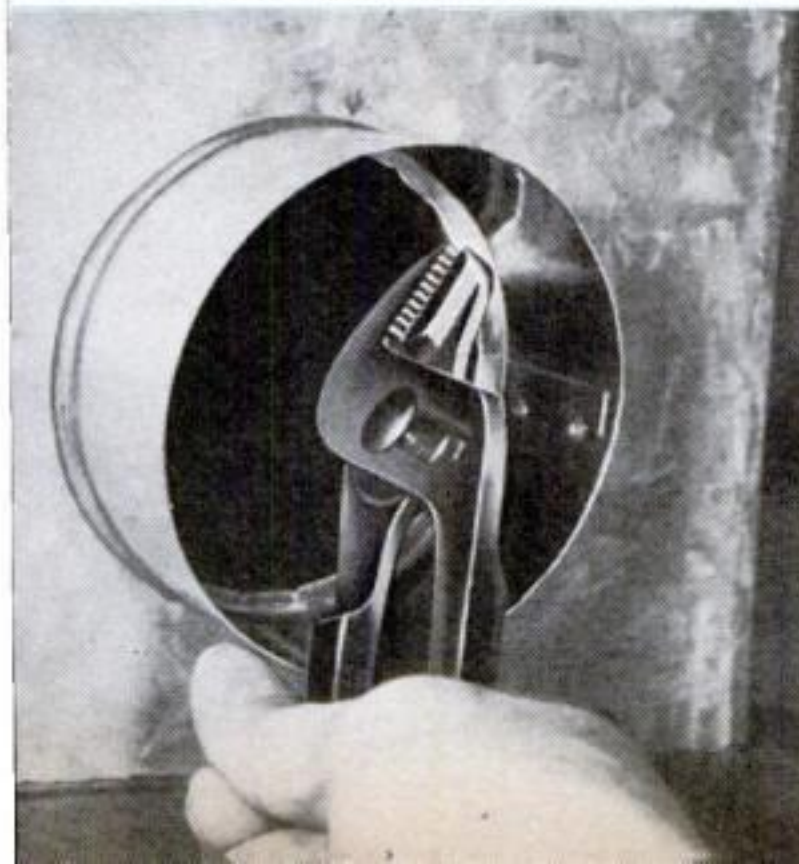
With the float in position, bend the tubular heating element to lie flat about $\frac{1}{8}$ " above the bottom of the pan, leaving the ends standing vertically to be anchored with tubing straps. At this point you *could* connect wires to the heater and operate the humidifier manually. In fact, it's a good idea to do so as a test.

To be efficient, the humidifier should operate automatically on dependable controls. These controls are available as separate units, and



STOVEPIPE FLANGE CONNECTORS are used to connect pipe to furnace and humidifier box. Crimp flange tabs to anchor them. To cut openings in furnace, drill a circle of small holes, snip metal between them and file smooth. Fit the pipe and tack-solder the joints.

ANNEALED TUBULAR HEATING ELEMENT vaporizes water in a stainless-steel pan. Element can be bent to fit pan after float valve is installed. Anchor the element on a bracket so it is $\frac{1}{8}$ " above bottom of pan, and bend float arm to maintain water level $\frac{1}{4}$ " above tube. As water is vaporized, float drops and valve opens to admit more water. The element is protected by a low-voltage circuit through water that shuts off humidifier if level falls too low.



CONTINUED

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need only be installed in a suitable box and wired together. The cost of operating the heater will be slightly less if you can wire it into a 230-volt circuit; but the unit will function equally well on 115 volts, and wiring is simpler.

As a precaution against burning out the heater if the pan should run dry, install a copper plate on standoff insulators at the side of the pan. Adjust the float

valve so that the water level stays about $\frac{1}{4}$ " above the heater tube, and bend the copper plate until it is immersed about $\frac{1}{8}$ " in the water.

Connect one leg of the low-voltage wire running to the humidistat to the plate and the pan, so that only the water completes the circuit. If the water level drops below the plate, the circuit opens, and the humidifier will not function. ■ ■

Electrical equipment needed

Control box	7" x 12" x 3" chassis
Terminal strip	8-contact type
Pilot lights (2)	115-volt filament bulbs.
1-amp fuse	Tubular type with spring-clip block
20-amp fuse	Screw type with base
Main switch	Household type SPST
Bypass switch	DPDT toggle
Control relay	SPDT Sigma, 11FZ-40ACS-SIL
Power relay	DPDT Guardian, 2200U-115 volts
Transformer	Stancor P-6467, 115-volt primary, 5-volt secondary

Equipment listed at left can be ordered from:
Allied Radio Corp., 1000 North Western Ave., Chicago 80.

Humidistat: Model H-64A-115 volt
Order from Minneapolis-Honeywell Regulator Corp., 2954 4th Ave., S., Minneapolis, Minn.

Heater element: Indeco #26C3-45-120-volt, 2,200-watt tubular, 45" long, .325" diameter, copper-sheathed, annealed

Industrial Engineering & Equipment Co., 24 Hanley Court, St. Louis 17, Mo.

HUMIDIFIER CONTROL

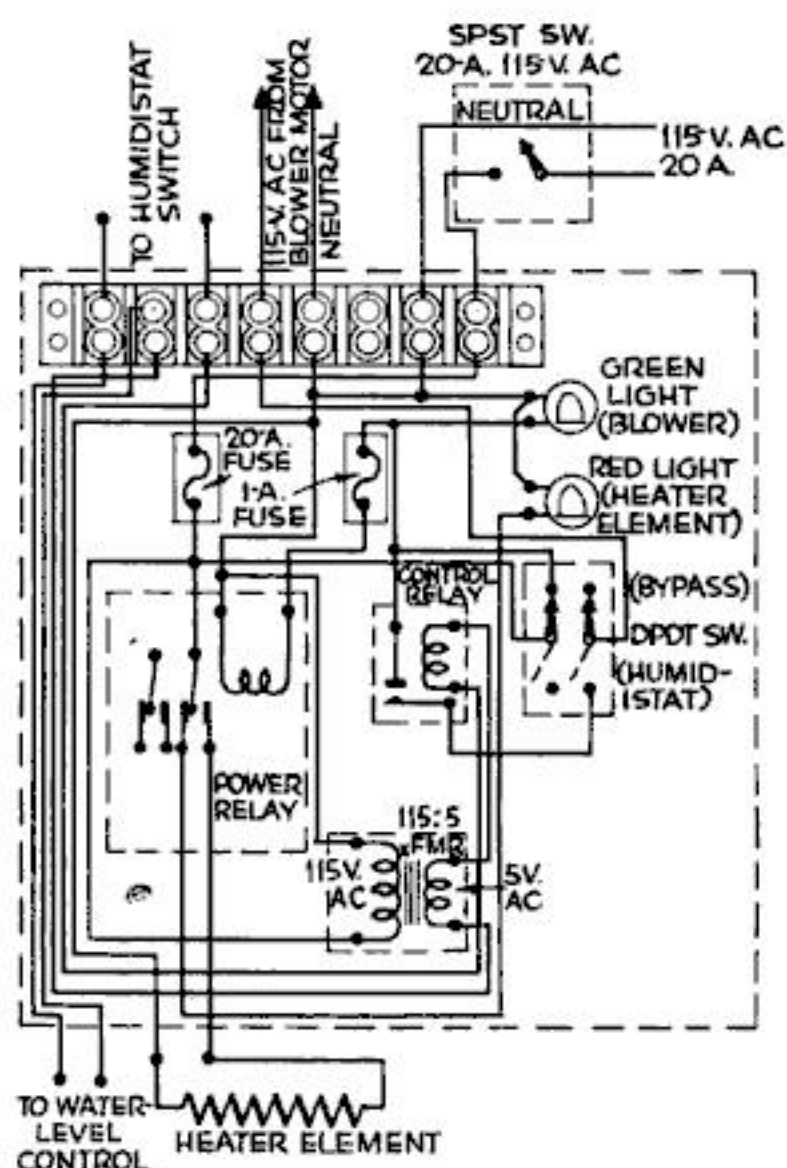
Starting Instructions

1. Check action of float valve
2. Open hot-water-supply valve
3. Check water level ($\frac{1}{4}$ " above heater)
4. Turn on main power switch (red light should go on)
5. Flip toggle switch to **BYPASS** (green light should go on, red off)
6. See that heater vaporizes water
7. Set humidistat for desired humidity (40% to 45% is recommended)
8. Flip toggle switch up to **HUMIDISTAT** for automatic operation

Fuses and Schematic Inside

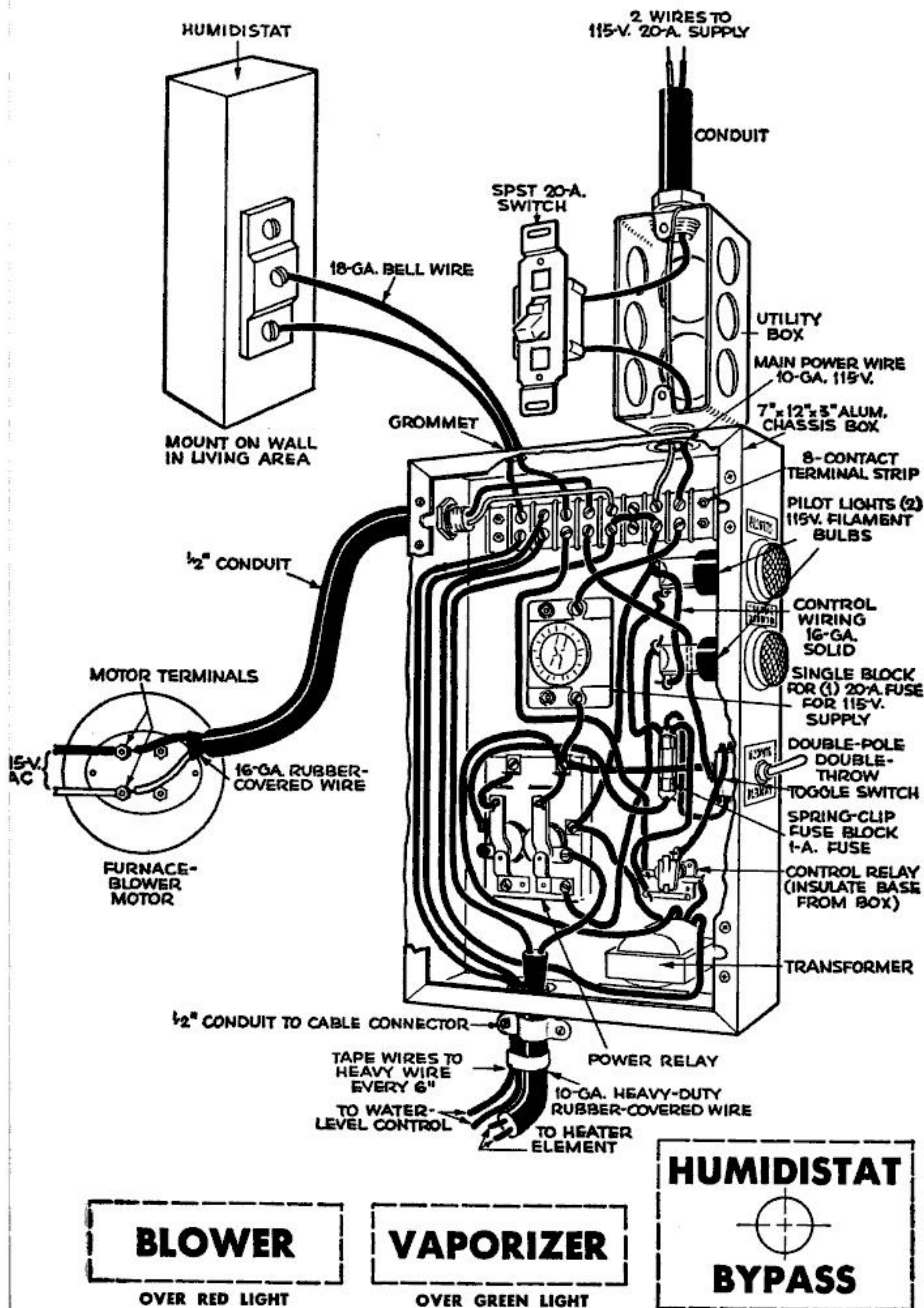
Turn off main power switch before removing cover

OPERATING INSTRUCTIONS and wiring diagram above should be cut out and pasted on the cover of humidifier control box. If you're unfamiliar with wiring diagrams, simply follow

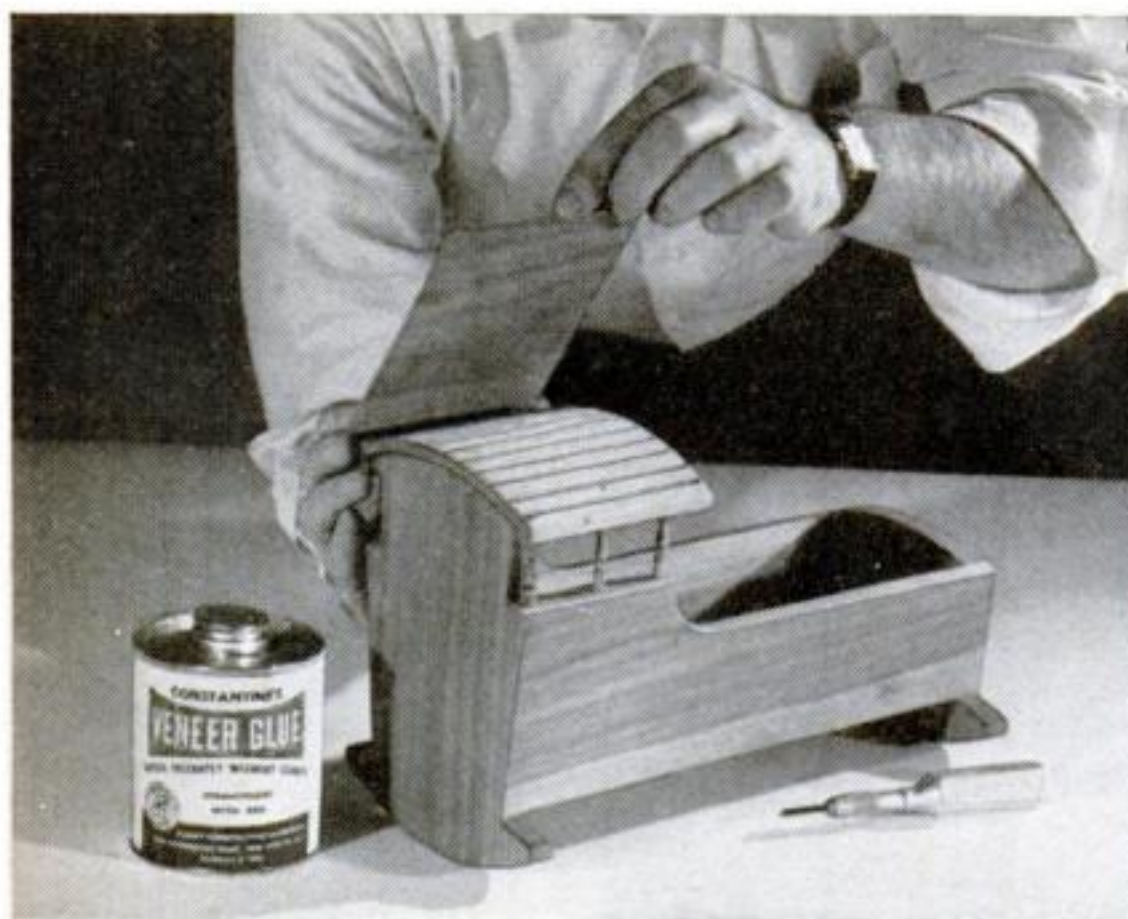


the drawing on the facing page and connect the wires as shown. Labels at right should also be cut out and pasted over indicator lights and toggle switch on the side of the control box.

Easy-to-follow drawing shows how wires are connected



Veneering Without



HARD-TO-CLAMP ITEMS are no problem with new contact glue. The curved hood of a doll cradle can be veneered after assembly (left), and a humble pork-and-bean can becomes a handsome vase (below).



By Henry B. Comstock

NOW you no longer need a shopful of clamps to turn out first-rate veneering. You can prove it with a beginner's kit offered by Albert Constantine and Son. The package contains instructions, a pint of glue, and an assortment of wafer-thin slices of walnut, striped African mahogany, Burmese teak, and Central American primavera.

The wood is unusual only in the eye-filling way of all high-grade veneer stock. But some of the information in the dope sheets may surprise you, and the adhesive certainly will. Called Veneer Glue, it's actually a contact cement, formulated for strength that will last the lifetime of a furniture piece. Here are the ways it simplifies and widens the scope of a craft that's older than King Tut's coffin:

- *No elaborate core stock.* The glue bonds veneer not only to sanded wood but to previously painted, shellacked, or varnished surfaces, provided the finish is sound. You can even use it to cover metal objects.

- *No warping.* Unlike even the finest cold-water-mix glues, the Constantine



glue doesn't first expand and then contract veneers, producing a drawing action on the core wood. On free-standing cabinet parts (doors, for instance), there's no need to apply veneer sheets to both sides. You simply place the showy material where it will be seen.

- *No clamps, no veneer press.* You can forget about the usual pressure-applying tools and those convex and concave forms or "cauls" you must build to hold veneer firmly against curved parts while ordinary glue dries. If you've ever used contact cement, you already know how the new veneer adhesive is applied. If you haven't, you'll be pleasantly surprised.

You brush two coats on both surfaces to be bonded and wait at least 20 minutes for them to dry. Then you bring the surfaces accurately together (you can't shift parts around, once they're placed).

Clamps

Finally, you either run a hand roller vigorously over the entire face of the veneer or tamp the part with a hammer and a cushioning block of wood.

- *No time lost.* It's usually best to cut veneer parts a bit oversize and sand or shave the excess off later. You can go right at this job after gluing. With other adhesives, you have to wait from 8 to 10 hours while they dry.

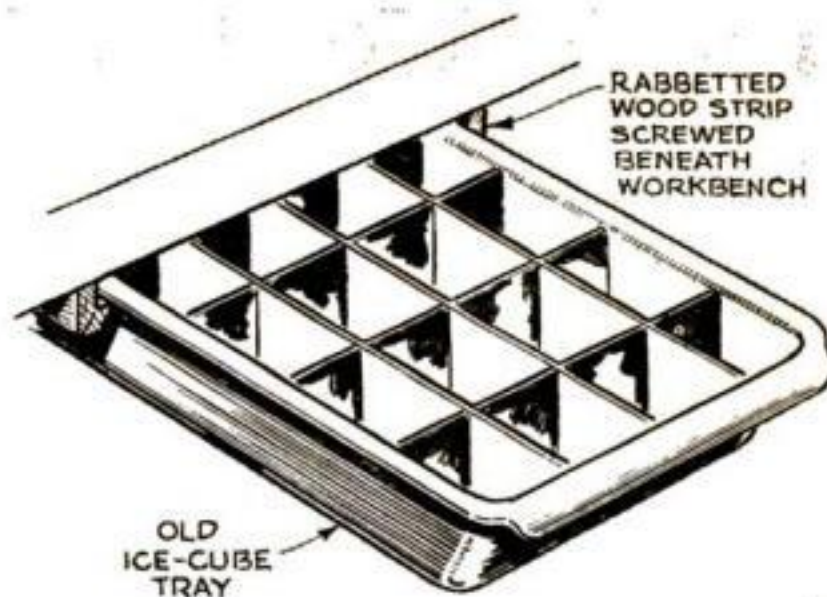
- *Greater gripping power.* The initial bond of the glue is so strong that veneer bent over small-radius curves has no chance to spring back if you press it down firmly as you apply it. The glue continues to toughen as it cures. It's highly water resistant and is unaffected by most chemicals. To clean brushes you swish them in lacquer thinner.

All this adds up to new and exciting craft adventures. Even a youngster or an all-thumbs adult can turn out attractive knickknacks—planters, vases, desk-top containers—formed by wrapping a piece of veneer around a tin can. Canisters and metal waste baskets will make bigger projects. If you can find a wooden cigar box you can turn out a handsome coffer for cigars or jewelry.

For old hands, veneering offers a change of pace from ordinary woodworking routines. Tackle one veneering project and you'll almost certainly awaken a keen interest in the distinctive grain patterns—the fingerprints of more than 100 varieties of veneer wood now on the market. You'll chuckle over claims that veneering is a "dishonest" craft.

You'll know that the main object is not to save a buck but to display handsome textures that are either hard to come by, or that present special problems. The highly figured grain of burl walnut, for example, is the result of disease, and a furniture piece built entirely of the stuff would fall apart. Other woods, like ebony, are so dense and heavy you'd need a block and tackle to lift a solid cabinet, bed, or table.

But why get technical? Most of the fun will come from turning something plain into something beautiful. By making it easy, Albert Constantine (2050 Eastchester Road, NYC 61) is offering a real Cinderella deal at \$2.75.

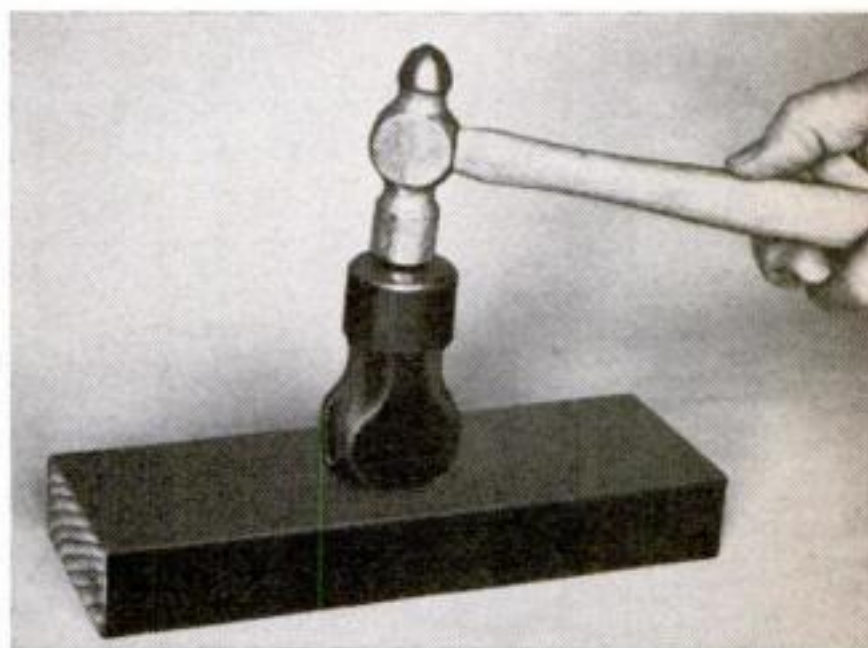
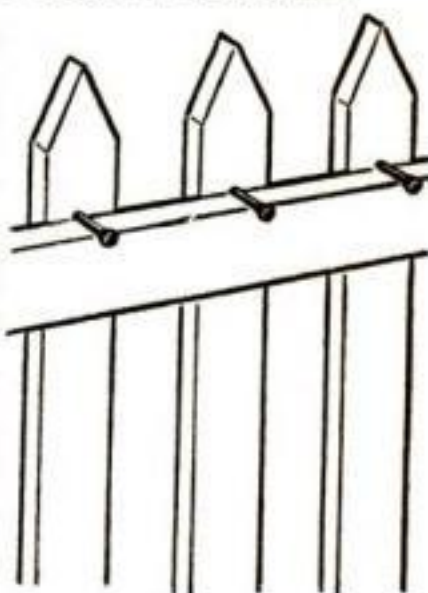


Ice-Cube Tray for Small Parts

AN OLD ice-cube tray (the plastic type with fixed partitions is best) provides a sorting tray for small parts, or storage bins for fasteners. Mount it on rails under your bench so it slides out of the way.—D. O. Van Gilder, Denver.

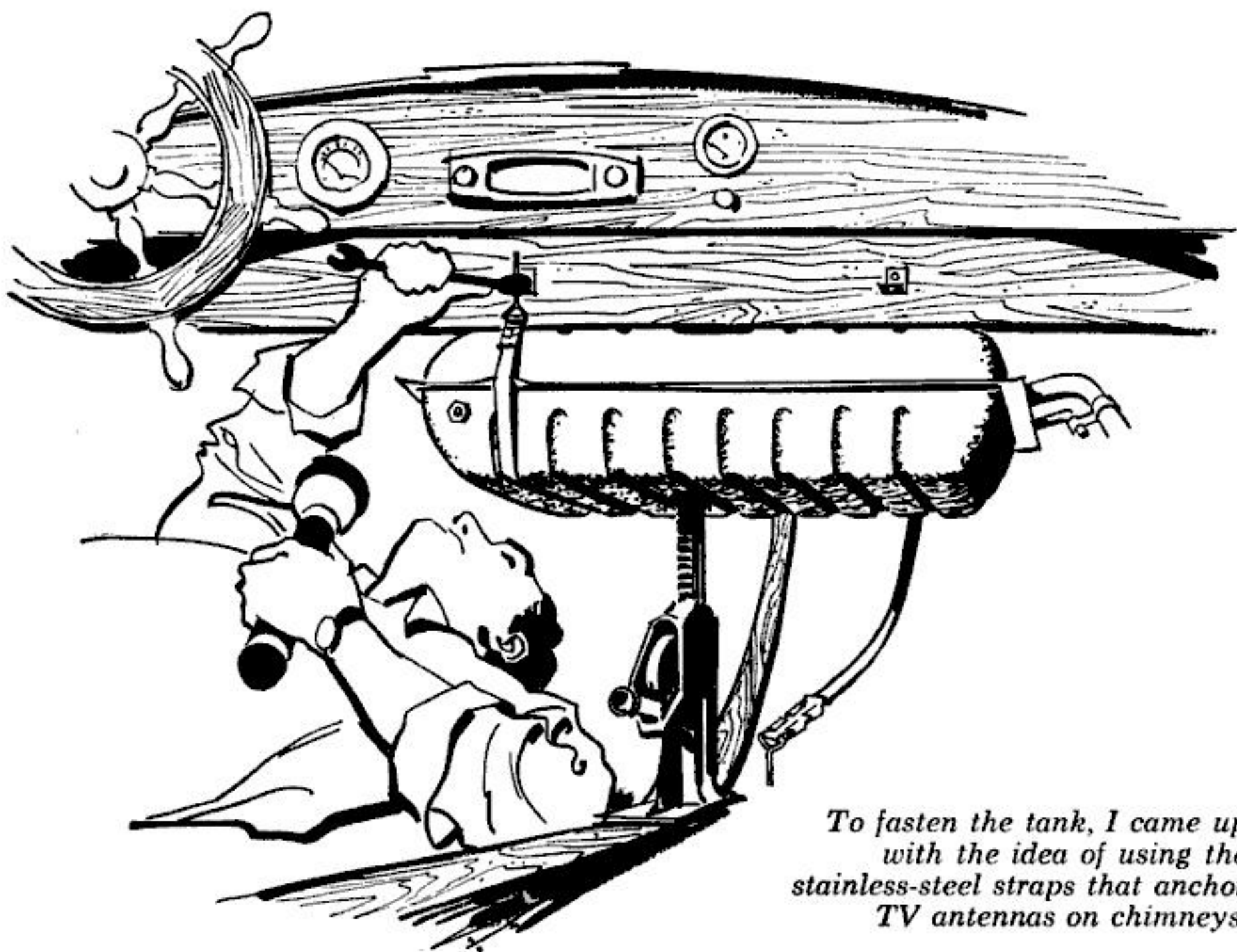
Nails Position Fence Pickets

ALIGNING pickets along a fence standard is no problem if you tack a long casing nail at the same spot in the back of each. Hang the pickets with proper spacing, nail in place, and pull out the hangers.—G. E. Hendrickson, Argyle, Wis.



Hammer Head Makes Small Anvil

SET the smaller end of a heavyweight ball-peen hammer into a snug-fitting hole in a short length of two-by-four. It makes a miniature anvil for such jobs as riveting, center-punching, and shaping small metal parts.—O. A. Nelson, Seattle.



To fasten the tank, I came up with the idea of using the stainless-steel straps that anchor TV antennas on chimneys.

An Auto Gas Tank Now Feeds My Outboard

By E. F. Lindsley

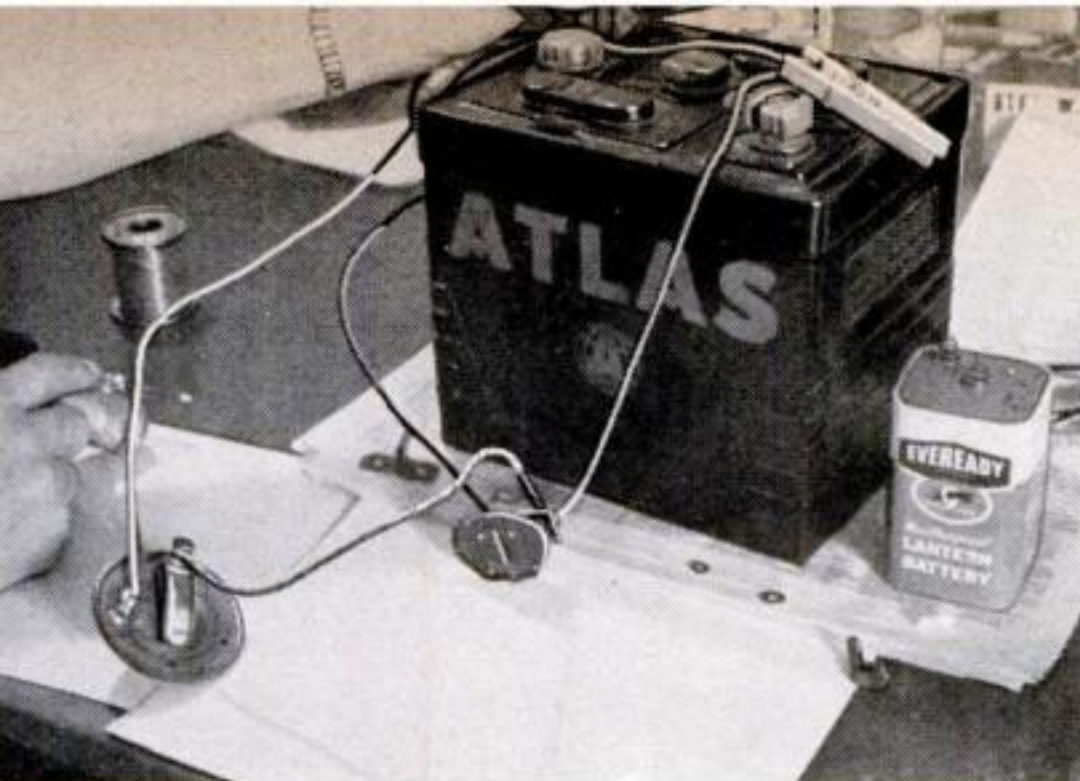
WHEN it got to the point that I was spending more time getting gas than I was enjoying my boat, I got the idea of installing a permanent gas tank. Someone suggested a tank from a car; they're cheap and have a built-in gauge unit.

A car tank holds 20 gallons or more, and gas weighs about six pounds per gallon. You can't place this weight just anywhere in a boat. I had one of the kids ride up front on the bow deck to see what would happen. My boat had always been a bit stern heavy, and the extra

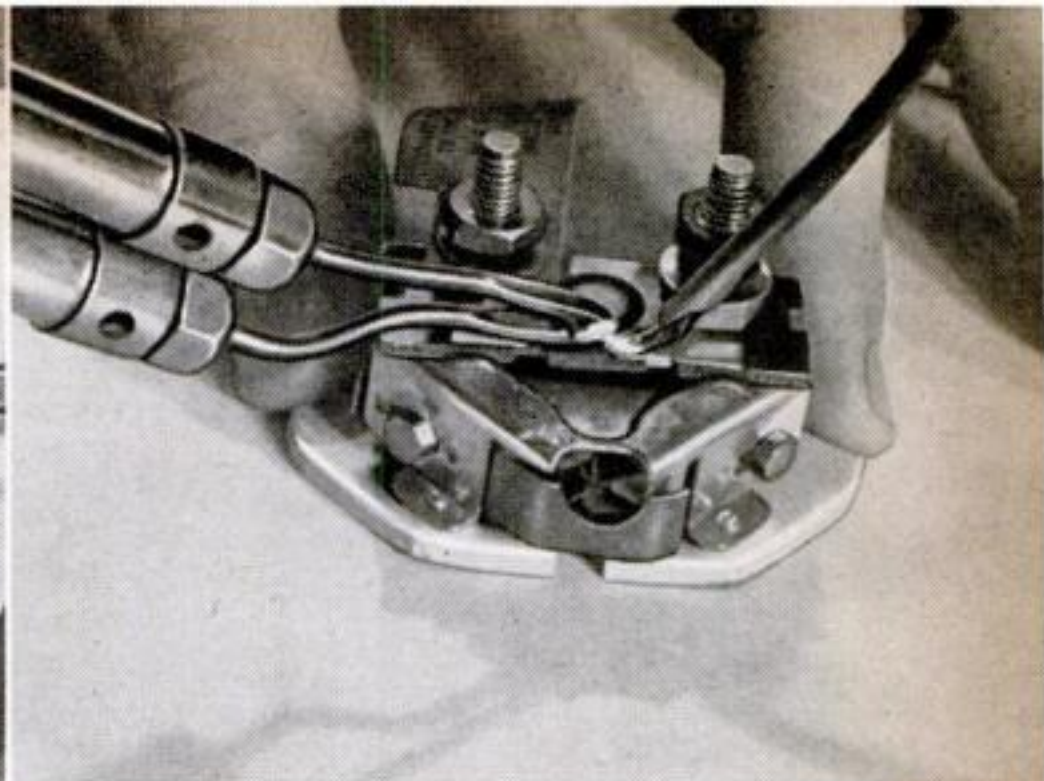
weight didn't seem to affect its performance. On a boat having less beam than mine, mounting the tank high under the bow deck might cause it to roll dangerously. To avoid this, try placing the tank low in the boat—under a seat, or on the keel up near the bow.

Another worry was the lack of baffles in a car tank to keep fuel from sloshing around in rough going. I decided not to worry about the baffles; and, it turned out, the tank worked fine without them.

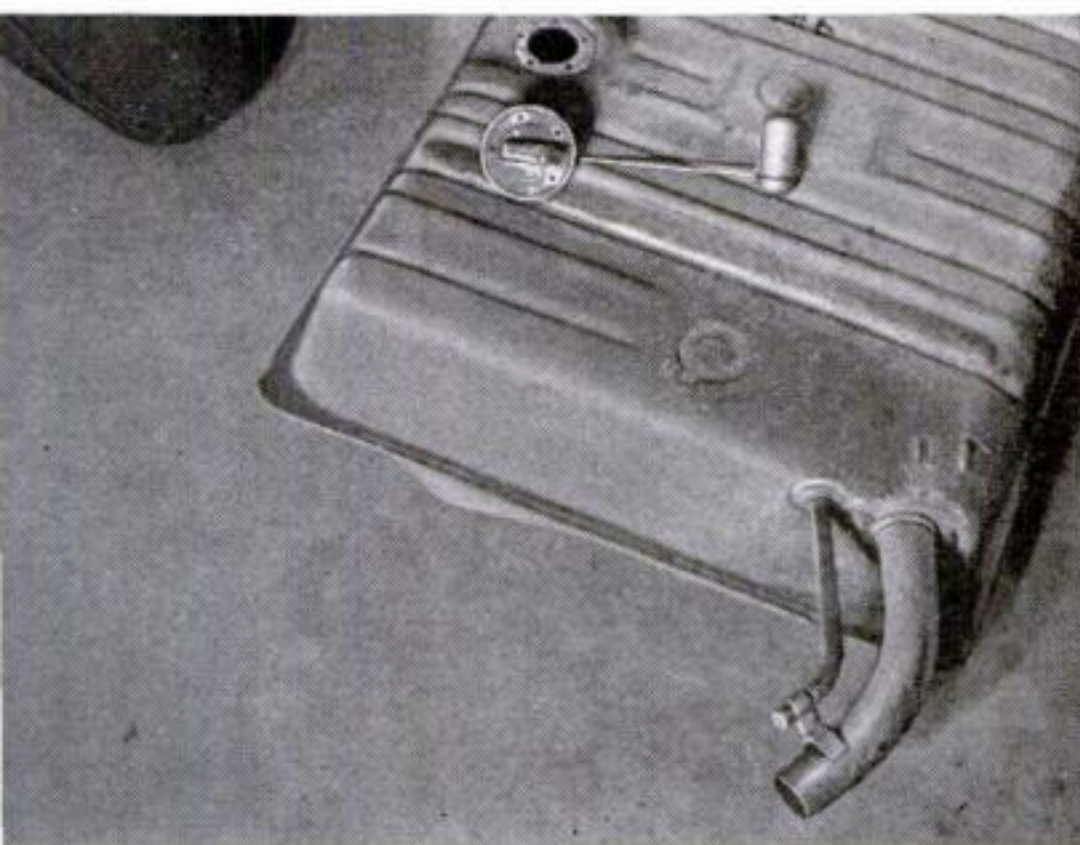
According to the Coast Guard, the filler pipe should extend down into a well in the tank so vapor can't rise up the pipe when filling. On the other hand,



GAUGE WAS CHECKED by hooking it up to the boat battery; a lantern battery wouldn't work. I ran a wire from the float frame to the battery, completing the ground circuit.



GROUND WIRE, soldered to frame of gauge, replaces metal car body that once grounded the gauge. Wire was passed through a hole drilled in the back of the case.



WITH FLOAT UNIT REMOVED, inside of tank can be checked for dirt, and cleaned. Filler pipe and vent tube, shown in foreground, are connected to deck fittings with hose.



TANK VENT IS A MUST. It should be installed at the edge of the deck or on the hull side to direct gas vapor overboard. Length of gas-proof hose couples it to the vent tube on tank.

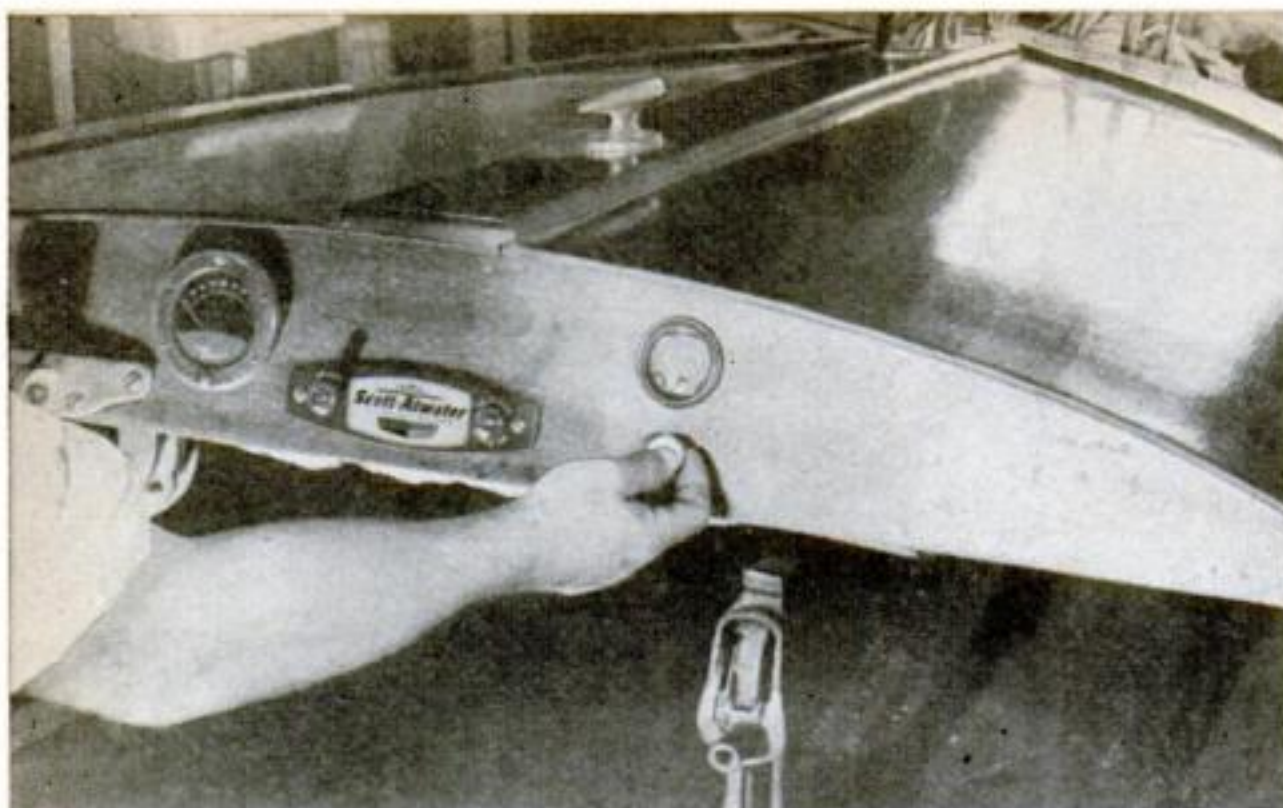
they also say that if the tank is properly vented away from the filler pipe, it's "fairly good." So I let it go at that. Messing around an old tank—cutting into it and soldering it—is dangerous business, and I wanted no part of it.

Before buying the tank, I'd checked on gauges and found that one type, used on Ford units, required a gauge voltage regulator. The rig used on GM cars needs only a tank unit and a dash unit, so I bought a tank and gauge from an old six-volt Chevy to hook up to the six-volt battery used by my outboard. The whole thing cost \$4. If you've a 12-volt job, try scrounging around the junkyards for

a setup from a more recent 12-volt car.

When the junky dragged out the instrument group from the dash of the Chevy, I was perplexed because the ammeter and oil-pressure and water-temperature gauges were all on the same big dial. After prying off the glass, though, I found that the gas gauge was separate, and held on by two screws. I later used these screws to mount the instrument in a case from an old pressure gauge I found in my shop junk.

All that was needed to make it fit was a light trimming of the gas-gauge face. Incidentally, don't get any ideas about lubricating the instrument pivots. These



SWITCH ON DASH saves battery by turning on gauge only when you want to check fuel supply. Pushbutton might be better here, since it would shut off automatically when released.

are specially doped at the factory with a sort of sluggish gook that serves to dampen the needle movement so the needle doesn't go crazy whenever the gas splashes around in the tank.

Gas gauges have been known to stop functioning, and rather than install mine and find it no good, I dragged in my boat battery and made a dummy hookup. Nothing happened. I moved the tank arm with the float on it, but the needle stood still. I checked the connections.

Then it dawned on me that a car is made of metal, and everything grounds to the chassis. I added a ground wire that completed the circuit from the gauge

unit back to the battery as in a car body. Now the gauge needle responded when I twitched the float arm. I had to include this wire in the final hookup to complete the circuit in the boat.

Cleanup. I gave the tank a good going over, too. Removing the float unit opened up a big hole that I could look into to check for leaks and dirt. I wire-brushed the outside clean, but there was a heavy layer of undercoating on the bottom that didn't seem worth the trouble of removing. I sprayed the tank with rust-inhibiting paint to make it look more shipshape, and to protect base metal.

Putting the tank in the boat was a workout. After trying unsuccessfully to juggle the tank with one hand and fasten it with the other, I pushed it into position with a jack placed on the keel.

One thing was certain. Twenty gallons of gas bouncing around every time the boat hits a chop is nothing to joke about. Casting about for a reliable means of securing the tank, I came up with the idea of using the stainless-steel straps that anchor TV antennas to chimneys. For about \$2 I bought a chimney-anchor repair kit, consisting of two long strips of stainless, plus eyebolts and clips to snug them up. Four $\frac{3}{4}$ " pieces cut from $1\frac{1}{4}$ " angle iron bolted against the deck beams serve as anchor points for the eyebolts at the ends of the straps.

Running the filler pipe to the deck was a problem. The car tank had a curved fill pipe and a smaller vent tube, both angled properly for the opening in a car fender, but not aimed toward the deck of my boat.

Safety hints for installing a tank

Install a tank vent to carry fumes overboard. Unlike smoke, which rises, gas vapor tends to settle. An accumulation of vapor in the bilge has the explosive potential of dynamite.

Be sure the tank is grounded to the filler pipe. Gas flowing through the pipe or hose generates static electricity, which can build up and create a spark. A grounded filler pipe discharges this electricity safely through the metal nozzle of the pump hose.

Before placing tank permanently, fill it with water and try it in several locations as you run the boat to check how weight affects performance.

If you enclose the tank, or install it in an enclosed compartment, ventilate the compartment with deck vents in addition to the tank vent.

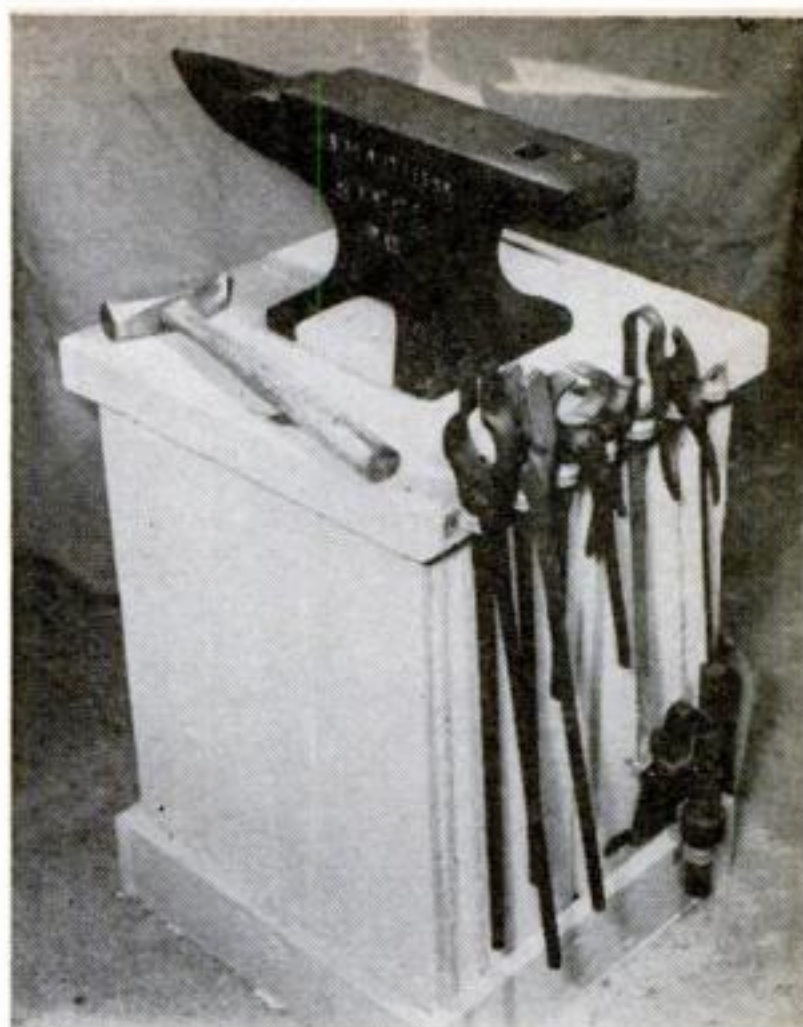
Rather than try to cobble up a redo of the Chevy pipe, I bought an authentic marine deck fitting with a cap chained to it. I fitted it snug in a hole cut in the deck and sealed it with bedding compound. Then I dropped a pipe and elbow down to the tank pipe, and connected the two pipes with a short length of hose. I also ran an electrical bond—a piece of stranded wire—across the hose to provide metal-to-metal contact between tank and deck fitting, so the tank would ground to the metal gas-pump nozzle when filling up. This is a necessary precaution to prevent buildup of static electricity during filling.

I also bought a marine tank-vent fitting with a screen in it, and installed it at the edge of the deck on the side away from the filler pipe. I coupled the vent to the tank with a length of fuelproof hose. If your boat has enough freeboard, install the vent in the side to pass fumes overboard.

Installing the fuel line. My outboard has a built-in fuel pump, so rather than fool with copper tubing, I ran an extra-long outboard fuel hose back to the engine. The hose has a check valve that closes when you disconnect it from the engine, but a shutoff valve at the tank is a good idea in case the hose should spring a leak.

If your engine uses a pressure system to force gas out of a tank—this type has a double fuel line consisting of one hose to pressurize the tank and another to carry gas to the engine—don't connect it to the new tank. Car tanks aren't built to be pressurized. Instead, leave the outboard tank connected to the engine, and put an electric fuel pump and a check valve at the car tank. Run a hose from the fuel pump, and let it feed gas into the portable tank as needed. A simpler method might be to use the car tank as a reservoir and refill the outboard tank manually when it's low.

After fitting the gauge to the dash, connecting the wires, and filling the tank, a minor problem came to light: As long as the gauge was connected to the battery, it would be pulling a bit of current, even when I wasn't using the boat. The answer was a switch on the dashboard to break the gauge circuit. When I get concerned about gas, I pull the switch and take a reading. ■ ■



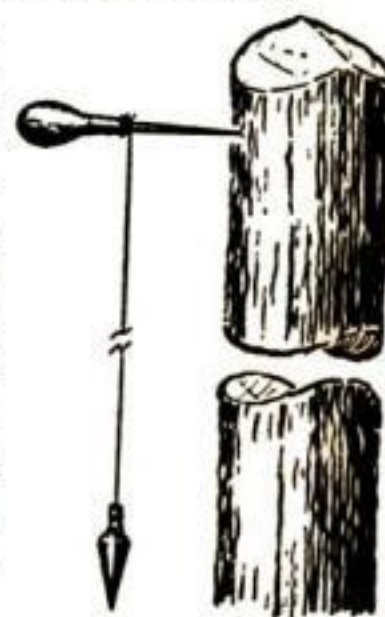
Sturdy Base for an Anvil

THE nearest thing to a fat tree trunk for supporting an anvil is a base made of four pieces of 8"-by-8" timber bound together with strips of 1"-by-3". Wood blocks, shaped to fit the heavy anvil, hold it in place without bolts. There's an old rule for figuring right working height: When you're standing erect with your arms at your sides, the knuckles of your clenched fist should touch the top surface of the anvil. —J. P. Goodenough, Milwaukee, Wis.

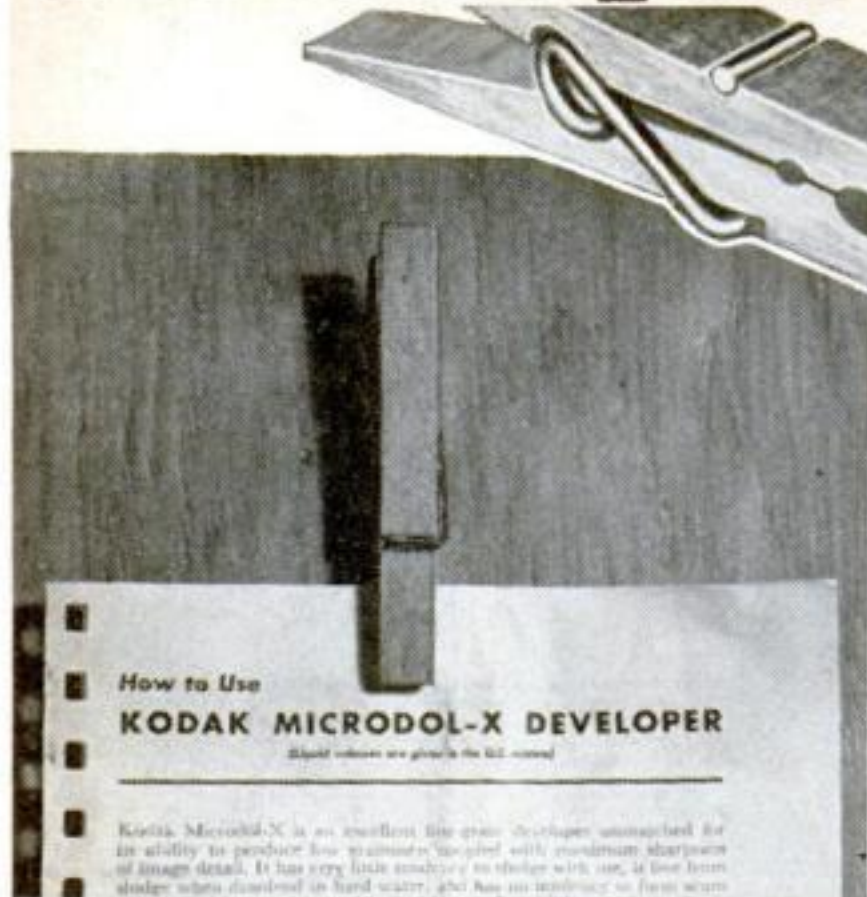
▶▶▶ MASKING or cellophane tape can be used to locate the spot where a door binds. Stick tape along the suspected area, and open and close the door several times. The tape will be marred at the tight spot.—Steve K. Hullcranz, Oak Park, Ill.

Awl Suspends Plumb Bob

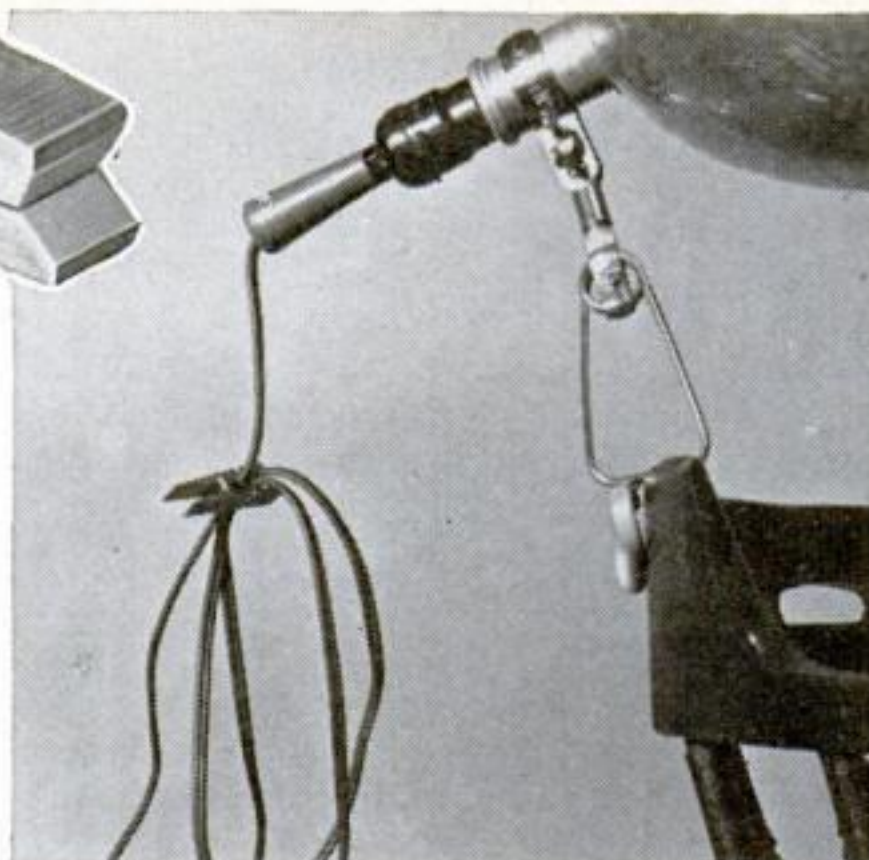
TO PLUMB fence posts quickly, tie the plumb bob to the shank of a bradawl with a length of string. Jab the awl into a post, adjust and set the post, then pull out the awl and stick in next post. —G. E. Hendrickson, Argyle, Wis.



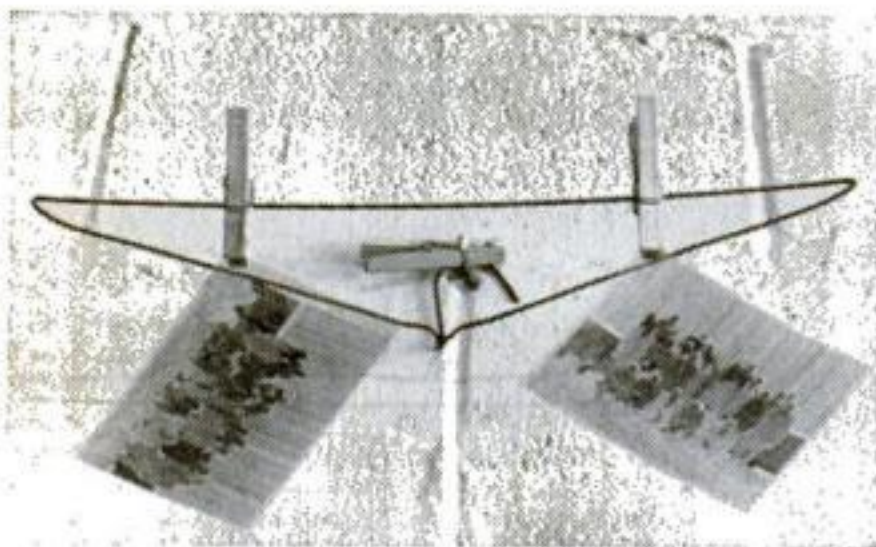
Clothespin Photo Tips



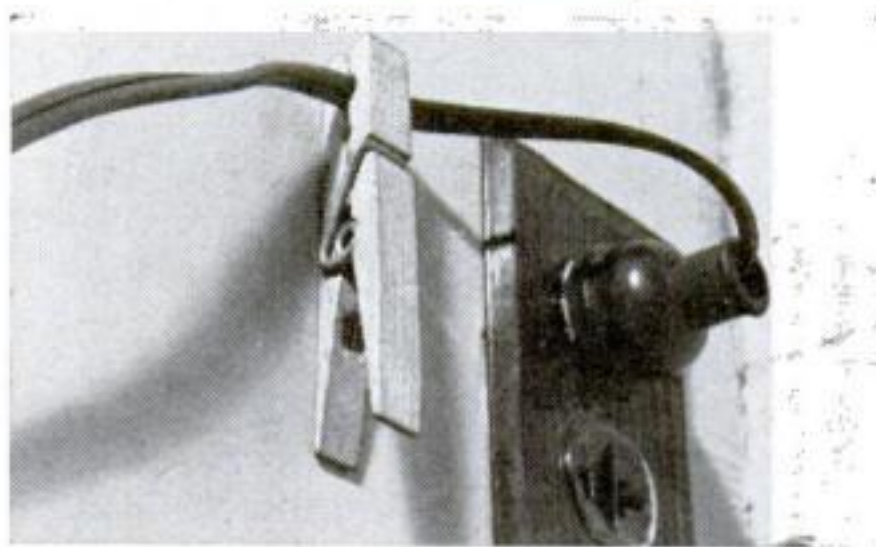
DATA HOLDER: Short memory? It's easy to keep instructions, indexes, and charts in front of you for reference while you work. Glue or tack a clothespin to the wall at eye level.



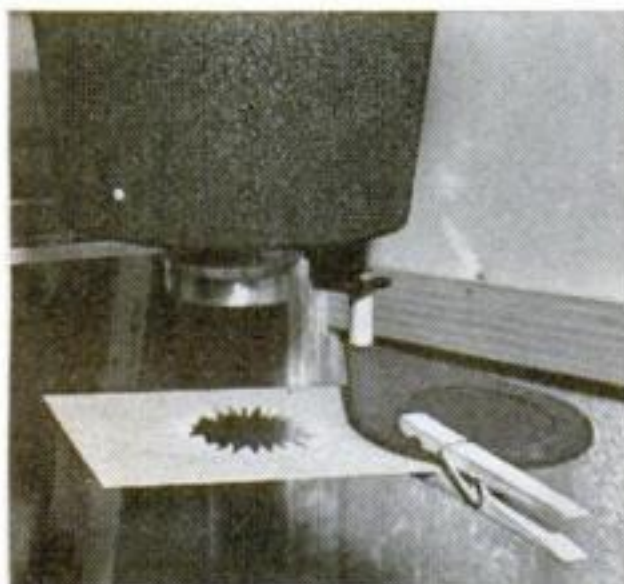
CORD CADDY: Treading on floodlight cords can cause shorts. When there's an excess of cord, keep it from underfoot by gathering it in loops held off the floor with a clothespin.



DRYING RACK: If you run out of space, or want to hang prints above a heater for fast drying, make an extra rack by bending back the hook of a coat hanger and clipping it onto a nail.



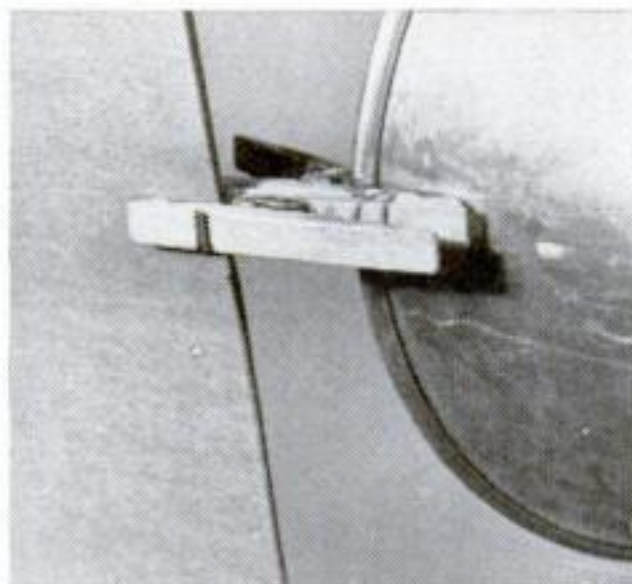
SOCKET GUARD: You won't accidentally kill your lights by tripping on the cord, if you screw a clothespin to the wall beside the socket. After you plug in, anchor the cord in the jaws.



MASK CLIP: Portrait work call for vignetting? Leave hands free by clipping the mask to the diffuser attachment on your enlarger. You can swing it aside when not needed.



WINGBOLT GRIP: If the adjusting screws on your light stand are too tight for fingertip turning, slip a clothespin over them to provide additional leverage.



LIGHT-SHIELD CLAMP: Join two clothespins with jaws in opposite directions. Grip flange of reflector with one, edge of cardboard with other. Repeat on other side for "barn doors."

PPG's sensational new LATEX House Paint resists blistering and peeling!

Protects homes years longer . . . Easier to apply . . . Goes over damp surfaces . . . Dries in 30 minutes



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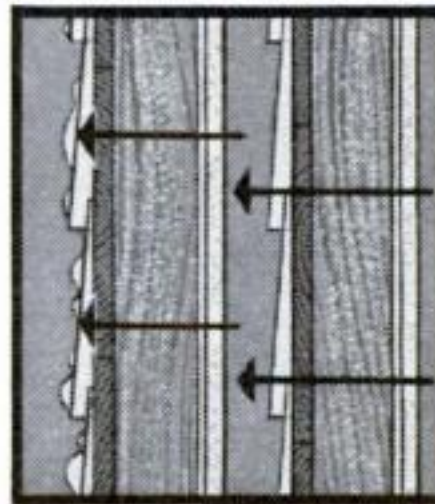
- New Pittsburgh LATEX House Paint can be applied over damp surfaces—also gives you greater ease and speed of application. You can use it with remarkable results on wood, brick, stucco, asbestos shingles, cement blocks or metal surfaces.



- Sensational new Pittsburgh Latex House Paint can keep your house looking "just-painted" years longer. The colors are fade-resistant . . . white stays white, colors retain their

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- You'll save hours because Latex goes on so fast and smooth! No brush drag, no lap marks. Use brush, roller or spray.



- Paint over damp surfaces! With Latex you can paint over surfaces damp with dew or rain . . . or paint between showers.

- Dries in 30 minutes! Forget about rain, dust and insects messing up your paint job! Latex dries in only 30 minutes.

- Resists blistering! Correctly applied, Latex resists blistering. It lets trapped moisture out, yet will not let moisture in!

- Clean up with water! Cleanup and brush care is a snap! Just wash brushes, roller or spray gun in plain soapy water!



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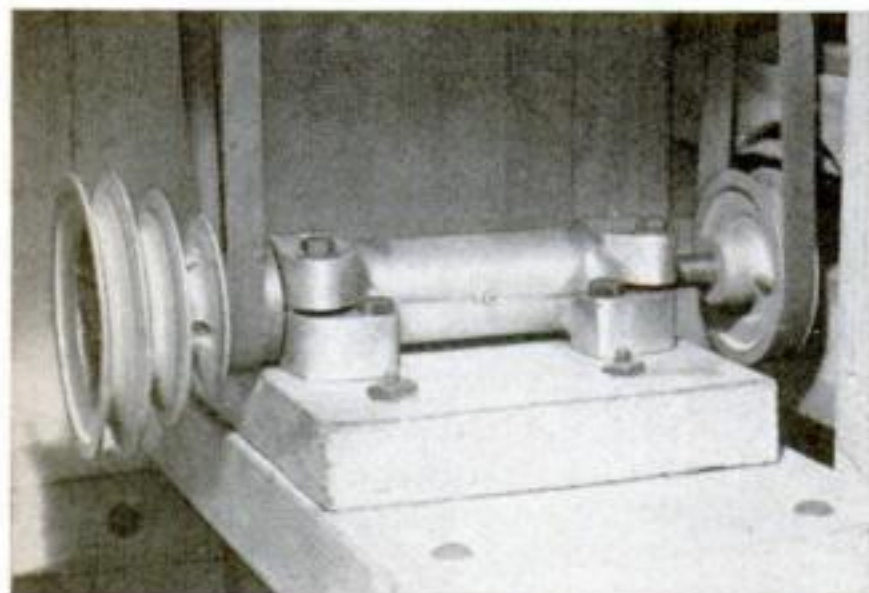
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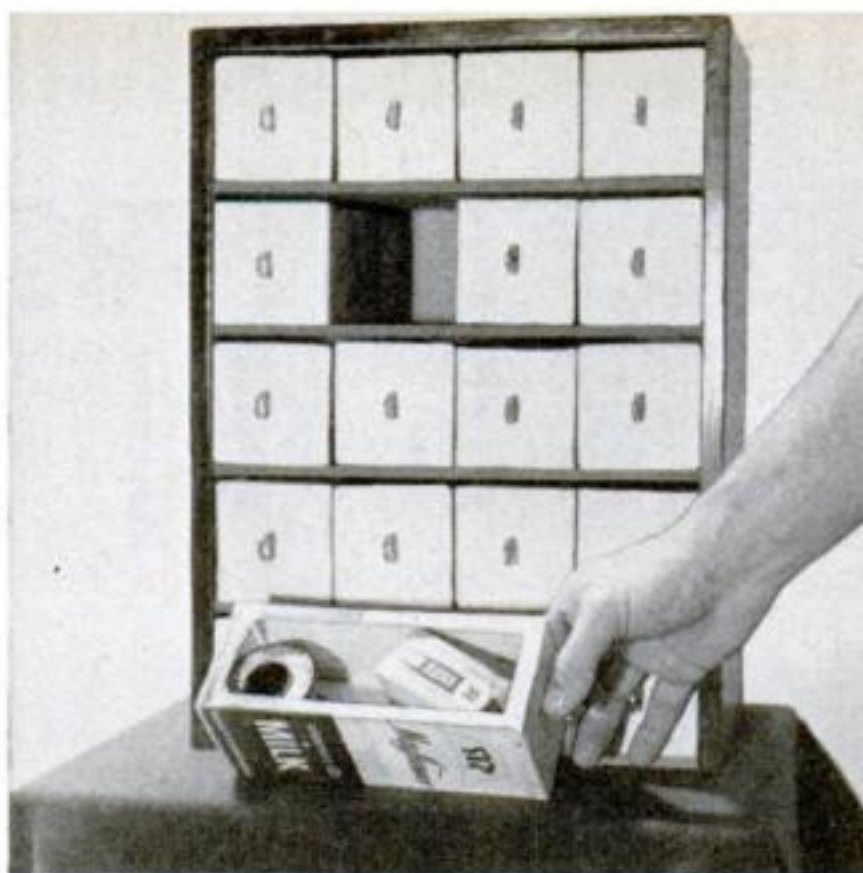
Short Cuts and Tips

FROM PS READERS



Heavy-Duty Speed-Change Shaft

DOES the speed-change shaft in your shop do such heavy duty that you can't keep bronze bearings in it? Try using a high-speed ball-bearing saw mandrel. These are built to take the punishment of swinging a heavy blade; and most of them are designed for pressure-gun lubrication.—*Herbert Y. Moon, Orient, N. Y.*



Milk-Carton Storage Drawers

A NEAT storage chest for small items can be made from scrap lumber and milk cartons. Cut out the carton tops and tack in plywood squares with screw-eye pulls. Slice out one side of the carton. Dimension the wood case (using $\frac{1}{4}$ " hardboard for shelves) to fit as many drawers as you need.—*R. Beach, Lake Grove, Ore.*

My Most Embarrassing Shop Moment

MACHINISTS and designers are always ribbing each other over who's at fault when a mistake occurs. The machinist accuses the designer of drawing the plans wrong, and the designer accuses the machinist of reading them wrong.

One day I drew up a little bushing that was nothing more than a short length of $\frac{1}{2}$ "-diameter brass rod with a $\frac{1}{4}$ " hole in it. Since it was a rush job, I hurried over to our machinist and asked him to turn out the part on the double.

A few minutes later, he appeared at my office and said, "Here's that bushing you wanted." Without batting an eye, he dropped a pile of brass chips into my hand.

Then he jabbed a finger at my drawing, getting howls of laughter from everybody in the room. The dimensions called for a



$\frac{1}{2}$ " hole to be drilled in $\frac{1}{4}$ " stock. There was no doubt that this time the boo-boo was mine—*E. C. Auld, Los Angeles.*



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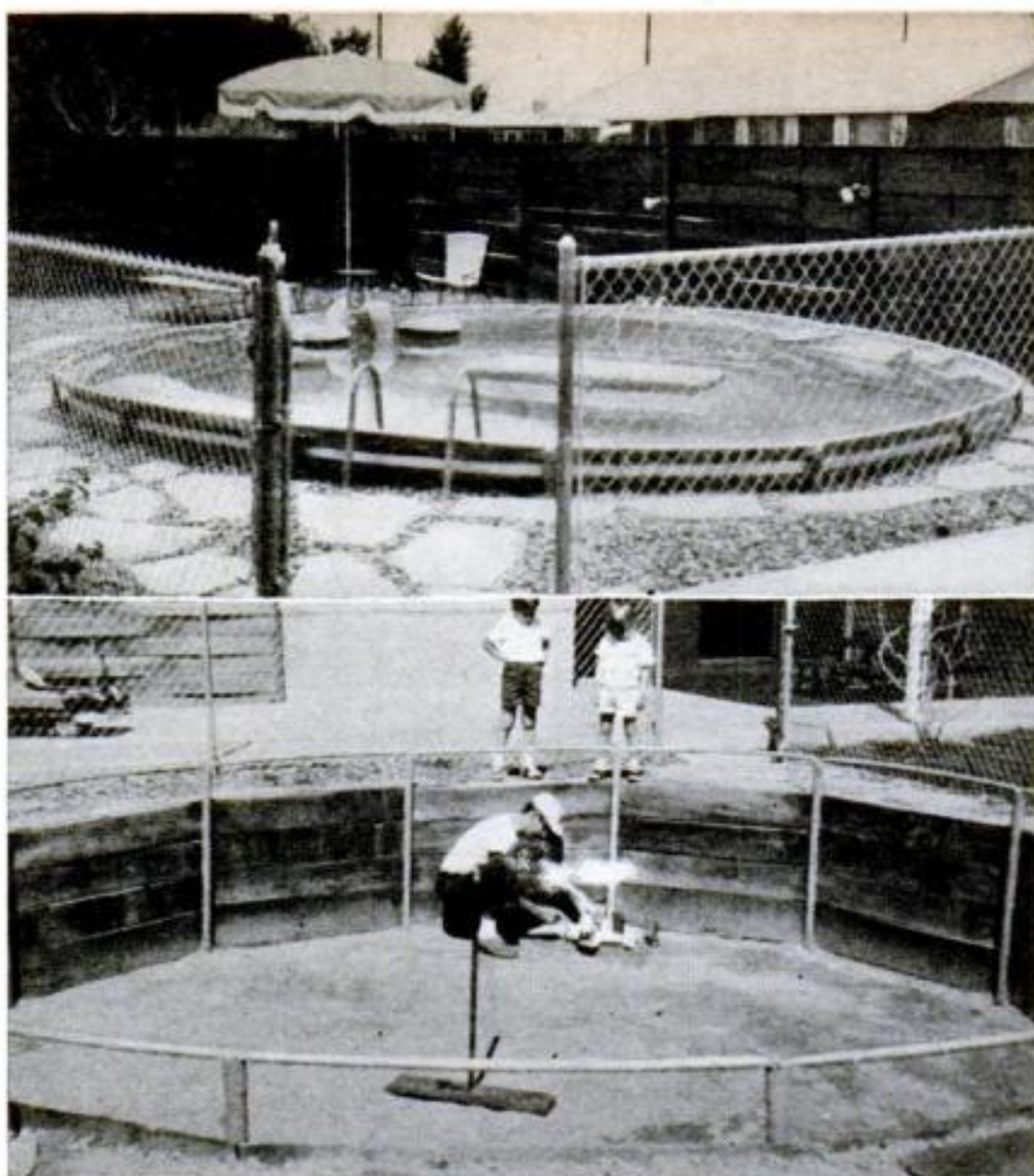
Write department 1 for catalog

Short Cuts and Tips

FROM PS READERS

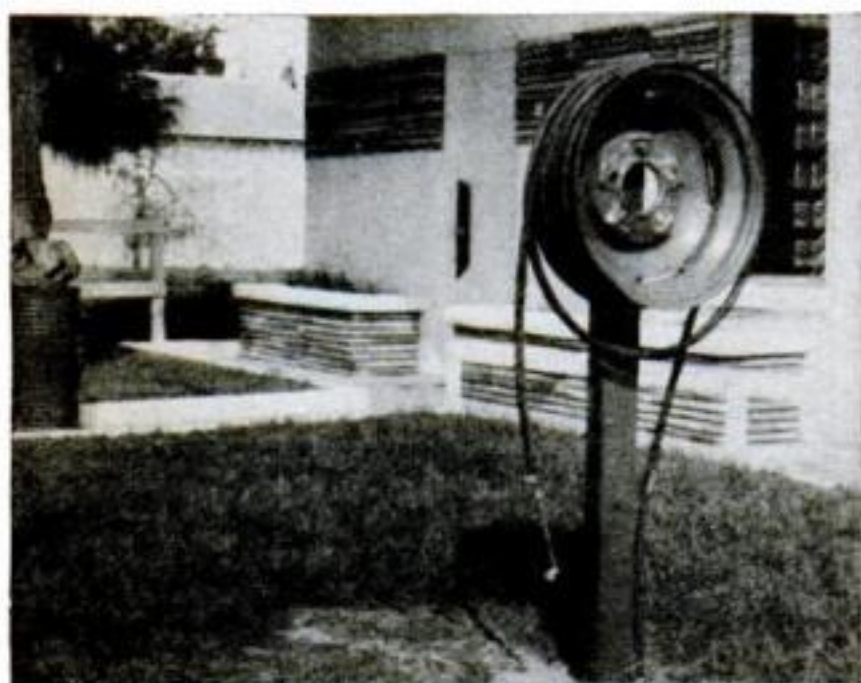
A Back-Yard Pool Goes Underground

ABOVE-GROUND plastic swimming pools can be given a swank in-the-ground look this way. Dig a pit to the pool's depth and about 1' larger in diameter. Set up the frame, then wedge 1" planks all around between the posts and the earth. The boards give you a cheap retaining wall and can be creosoted for longer life. Between pool seasons, I get extra mileage out of the pit by using it for flying model airplanes from a central tether.—*Donald E. Mowrer, Phoenix, Ariz.*



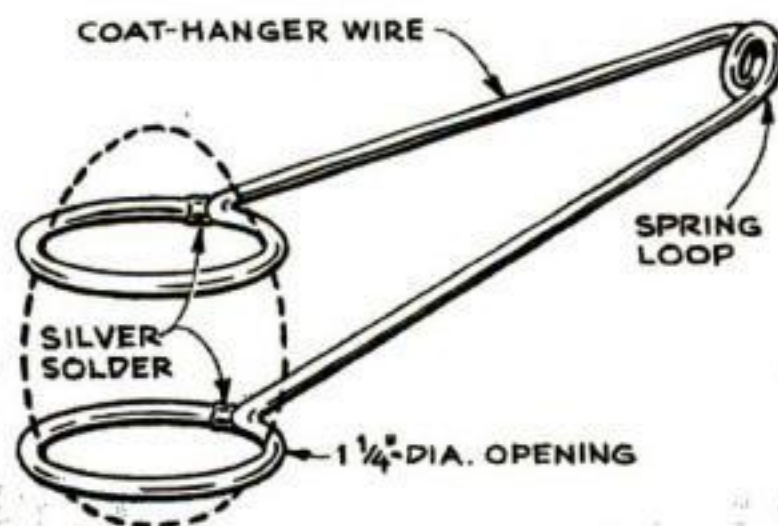
▶▶▶ DOES your wife complain of having to jam tablecloths and other linen in a drawer too small for them? Wrinkles—and ruffled tempers—can be avoided by folding them over curtain rods mounted on the back of a cupboard door. Or fasten swing-out towel bars in an under-counter cabinet.—*J. Ogle, Mankato, Minn.*

▶▶▶ IF YOU need a replacement nut for a foreign car using Whitworth or metric threads, you can usually borrow an emergency spare from a fuel-line clamp, bracket, or other spot not essential to the running of the car. This trick helped me out of trouble on the road several times.—*Mel Halle, Playa Del Rey, Calif.*



Handy Reel to Store a Hose

AN OLD wheel rim on a post makes a good reel for storing an air or garden hose off the ground. For the neatest effect, run the hose underground to the post.—*Harry J. Miller, Sarasota, Fla.*



An Egg Lifter That's Safe

THE easiest way to remove hot eggs from boiling water, I've found, is with a lifter of coat-hanger wire bent like this. Eggs can't fall out of the loops.—*H. C. McClellan, Willow Grove, Pa.*

France's Fabulous Flivver

[Continued from page 65]

Top speed is 50, and fuel mileage about 53 miles per gallon. The gas tank holds only $5\frac{1}{4}$ gallons. "It's enough," said our hostess, "for two round trips to the city and back, with some left over." She lives 50 miles from New York.

The car's interior is starkly utilitarian, with enough sharp edges to make the National Safety Council frown. Front windows are halved to hinge up from the bottom, and are locked with mouse-trap catches inside. Controls are confusing at first; there is no gas gauge, and the speedometer looks as if it had been taken off a bike and mounted in a corner of the windshield at the last minute. The shift lever sticks disconcertingly out from the middle of the dash; it has a naïve swing-link connection to the transmission in front of the firewall.

Engines fore and aft. For some of the rough terrain the little cars are used in, buyers suggested four-wheel drive. Citroen tackled that problem with characteristic forthrightness. Clutter up the flat underpan (a feature of all Citroens) with a drive shaft? Never! Instead, a second 2 CV engine was installed in the rear and geared to the back wheels. With 24 hp., this model weighs little more than the standard one.

The Deux Cheveaux, Citroen bosses feel, isn't for the American market. "It would just be laughed at there," said one. But a new, slightly larger version, the AMI-6, will soon be coming over. It has many of the smaller car's features, a less Spartan interior, and a body you can look at without wincing. ■ ■

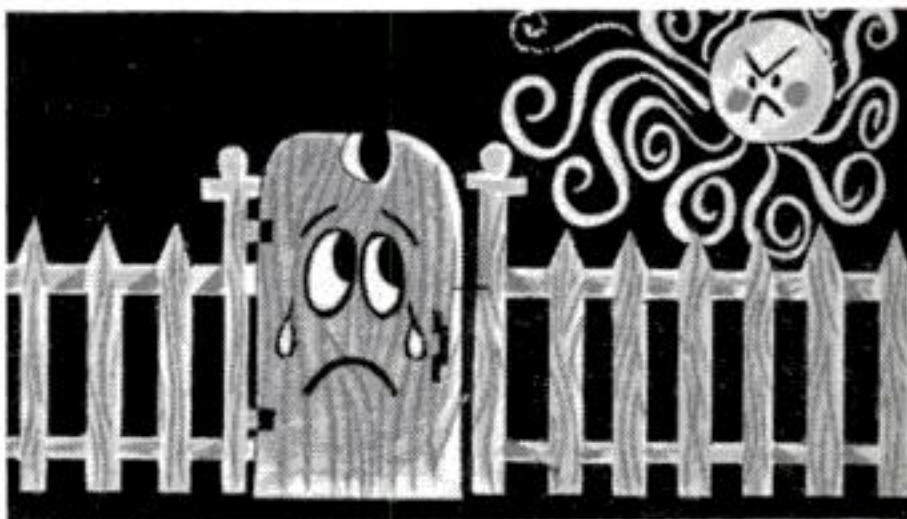
Coming Next Month: 50-Page Home-Improvement Supplement

For September, Popular Science brings you its annual Home-Improvement Supplement—50 pages of new ideas, products, and projects for your home. Samples: a garage workshop from space made available by a compact car . . . shell houses that you can own for less than rent money . . . new glue-on decorative brick . . . easy ways to install wrought-iron railings . . . a rear-projection screen that gives you a home movie theater. And that's only the beginning of what's ahead. Don't miss this fact-packed issue!

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Products of United States Plywood



Although about 80 percent of warm-air homes have some sort of humidifier, it's been estimated that less than five percent of these devices are capable of putting out the required minimum of six gallons a day. Of hot-water-heated homes, less than two percent have adequate humidifiers.

Which machine does the job? Actual moisture output is more important here than method of operation. You can buy a good humidifier of almost any type—but shop carefully.

Of some two dozen models studied by POPULAR SCIENCE, rated capacities ranged from a whopping 80 gallons a day down to less than 3. Most of the plate types were found to deliver less than the 6-gallon minimum unless equipped with an auxiliary heating element.

In models designed for furnace installation, the majority of force-type humidifiers put out a respectable 7 to 12 gallons a day. In console and portable models, however, the same basic systems don't always do as well—some outputs fall below the safe minimum.

You'll find capacities listed in many ways—by the hour as well as the day, and in pints, quarts, gallons, even pounds. Convert these to a meaningful figure—gallons a day. A 40-pint output sounds big until you realize it's only five gallons. (A pound, of course, equals a pint.)

Be wary, too, of makers who refuse to list outputs, substituting such catch phrases as "Keeps the air moist and healthful." This is double-talk. A few humidifiers are also rated according to the number of rooms or the cubic feet of space they'll handle—a useless statistic unless you know what level of humidity is being promised.

Figuring your needs. You must also remember that rated capacities are maximums, under ideal conditions and continuous operation. But no humidifier can or should run constantly. In warm-air furnaces, it usually operates only when the blower is on. A humidifier with a rated capacity of 10 gallons a day is putting out only 5 if the blower is off half the time. For this reason, it's best to have a heating contractor estimate the needs of a warm-air furnace for you.

In warm-air systems, atomizers appear to have a slight edge. Their installation

is simpler and their prices somewhat lower—\$60 to \$100. A good vaporizer runs from \$80 to \$120, with some models going to more than \$200. However, vaporizers are well suited to hot-water systems since you already have the heated water they need on hand. The pad or drum types of forced evaporators generally have good capacities and can be used with any heating system.

Hard water can be a problem. If you live in an area with hard water—say 15 grains or more—you'll have to decide which of several nuisances you'd rather put up with. Hard water is a problem with every type of humidifier. With evaporative models, minerals clog the filter pads or plates. With vaporizers, the minerals encrust the heating elements. With atomizers, tiny mineral particles can be injected into the air to settle out as dust. Nozzle types can also clog up.

The only solution is an appliance that adds around \$50 to the installation—a demineralizer hooked between your water supply and humidifier. Water softeners are no substitute, since they don't produce mineral-free water.

To overcome the mineral-dust objection, some atomizers mount in the cold return side of the furnace, instead of the hot side. This way, the moisture-laden air must first pass through the furnace filter, which traps out some of the deposit. In other models, the water is sprayed against a gridlike plate that acts as a partial filter.

Are automatic controls necessary? A humidistat turns your humidifier on and off as it's needed, much as a thermostat controls your furnace. Most humidifiers either come with one or can have one added for an extra \$15 to \$20. One new type made by Minneapolis-Honeywell costs only \$12 and requires no wiring—you plug the humidistat into a wall outlet and plug the humidifier into it.

Automatic controls are a useless expense on a low-capacity humidifier that must keep grinding away. But they're important on models capable of producing too much humidity. Your safest bet is to buy a unit that can supply the maximum moisture your house is likely to require. You can always throttle it down. ■ ■



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The Craziest Sport in the World

[Continued from page 45]

down on the wheel with his right. Down the straightaway he flattens his foot on the throttle, not abruptly enough to break the prop free and cause it to cavitate like a car spinning wheels, but just enough to get maximum acceleration.

As engine r.p.m. climb at first, boat speed lags behind. The driver learns at what point boat speed matches and begins to override engine speed; then he slacks off slightly so as not to overwork his power plant.

To win races, a driver must enter a turn at 120 to 130 m.p.h. By the time the boat has completed the turn, the drag of sideslipping and propeller slippage will have reduced speed to 85 to 90.

Cornering a Gold Cupper isn't a matter of coming up to a turning buoy and swinging the wheel left. Though each boat will have its own characteristics, a driver must always start his corner before he actually reaches the turning buoy. He must learn to sense a shut-off point before he reaches the first pin; then he'll turn the wheel slightly to the left and let up on the throttle for an instant.

When his boat speed overruns engine speed, he'll straighten the wheel again and add throttle, and the boat will move into a slight controlled slide, bow pointed toward the oncoming buoy. With a series of gentle turns to the left, followed by wheel correction to the right, the boat will move in a broad sliding manner through the turn. The driver's hands are never at rest on the wheel. He feels the boat's movement, recognizes how the boat will react with each oncoming wave, and constantly plays the wheel.

Ready for the race. Up to this point the operator is helming the boat alone on the water. In a race his job is far more complicated. At a five-minute warning gun, boats enter the course, working out their strategy for the start. Later, a one-minute warning gun is fired.

Each driver attempts to reach the start just as the final second ticks away. If he jumps the clock he must run an extra lap and will be hopelessly last. During the final 2,000 feet of run toward the start, drivers must maintain a straight course.

The run down the starting chute is often made at a speed well above 160 m.p.h. The driver of each of the starting

The Craziest Sport in the World

boats (up to six are allowed in a heat) knows the tremendous advantage of getting first to the corner. If he leads, his vision will be unobstructed by the 30-foot-high, often 500-foot-long rooster tail of spray thrown up by each boat's propeller; the water will be undisturbed, and his prop will get a firm bite in solid water. Often all six starters will scream side by side down the chute less than a boat's width apart.

A late starter must drive blindly with water from rooster tails flailing his boat and lashing his face with the force of a dozen fire hoses. Drivers soon learn not to close directly behind a competitor. A boat taking the force of a rooster tail between the two forward sponsons can be lifted into the air like a kite in a gale, or its engine will gulp water and be "washed out."

It's tougher than Indianapolis. Remember, these racers have no brakes, and their speed often exceeds that of a racing car. Instead of riding smooth macadam or concrete, boats bound from wave crest to wave crest or thud with teeth-jarring jolts over choppy surfaces. It's more like driving a race car with solid tires at full throttle over railroad ties.

Even the driver leading the pack has trouble spotting the buoys, for the pounding distorts vision. Stationary objects seem to shift and blur. Buoys are bright orange, five or seven feet high, but at better than 100 m.p.h. they look like fishing-line bobbers.

Disaster can strike at any time. Savage vibration may rupture a fuel tank or snap a fuel line. At any instant he may be sitting in a flaming inferno from which he won't dare leap until he has killed off his speed to less than 70 m.p.h.

The hulls are ruggedly built and often partly sheathed with aluminum. Yet a single loose screw or sheared bolt can start a chain reaction. A section of planing surface may tear free, causing a disastrous flip.

A pot of gold is needed to sponsor a Gold Cupper. Though a boat can be launched, ready to race, for \$20,000, to campaign one calls for a skilled pit crew of a half-dozen specialists. Perhaps \$50,000 a year would be a minimum budget for the individual or syndicate sponsoring one of these boats. ■ ■

How the dip-stick spots engine trouble!

Does the dip-stick in your engine crankcase show up costly oil loss?

If it does, better have an experienced engine mechanic check your engine for bearing wear.

More than likely, he'll find that dropping oil levels on the stick are linked to poor engine performance. And here's why: once bearings wear beyond the engineered clearance point, oil pressures drop. Surplus oil splash goes wild. Uniform lubrication is lost. Excessive oil flies onto the cylinder walls. It is pumped into the combustion chamber where it burns into carbon. It fouls plugs. Deposits pile up on valves and piston rings. Rings cease to flex and menace compression.

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Tiny Two-Wheelers Use Little Gas

[Continued from page 85]

if they're small and fat and have disk centers, you're looking at a scooter.

Optional features. The array of special-equipment options is bewildering. As may be expected, the lowest-priced machines generally offer the least standard equipment. Many are priced less lights, mirror, and horn, though some states require these accessories. But these are safety fittings that should be on any vehicle, regardless of the law.

Battery-powered lights are acceptable, provided you remember to keep fresh batteries in the holder. Hand-operated horns are also legal. Some engines can be fitted with a built-in generator to power the lights. Such a setup provides alternating current, which works fine for lighting. A point to remember, however, is that some of the low-voltage flywheel generators don't regulate too well. While traveling at a good speed, you'll have plenty of power for good, bright light, but if you slow down, the juice drops drastically—perhaps just when you need it most. Many of the more expensive vehicles have small batteries as well as generators to keep them fully charged.

If you do much traveling along dusty or gravelly secondary roads, a set of fenders also would be a good investment.

Practically all of these two-wheelers have clutches. The cheapest type is the simple centrifugal clutch that works on the primary V-belt drive. When the engine's shaft exceeds a predetermined speed, the clutch engages automatically by centrifugal action. A slightly more expensive type of centrifugal clutch, in conjunction with a special countershaft, will allow a smooth form of automatic "gear shift," though no gears are actually involved. The most expensive rigs have manually operated clutches and two or three gear speeds.

Ride comfort also increases with cost. The simplest and cheapest scooters have no springing—except for the fat low-pressure tires and possibly a fairly thick, padded seat. But even the most basic type of front-fork springing pays real dividends in absorbing some of the jolts you get from a rough road. The more expensive machines have well-sprung forks with shock absorbers built in. Still more deluxe are ones with a sprung rear

Tiny Two-Wheelers Use Little Gas wheel as well. These features are highly recommended, unless you're looking for the ultimate in low cost and are willing to absorb all the road shocks yourself. Remember that those little scooter wheels will drop *into* a hole that a bike wheel would bridge with only a slight jar.

For high-speed road work and in mountainous country, a front-wheel brake is useful. For the latter you should also consider a machine with multispeed drive.

Some vehicles near the \$300 mark come equipped with electric starters, but few have such large engines that they can't be started easily by foot.

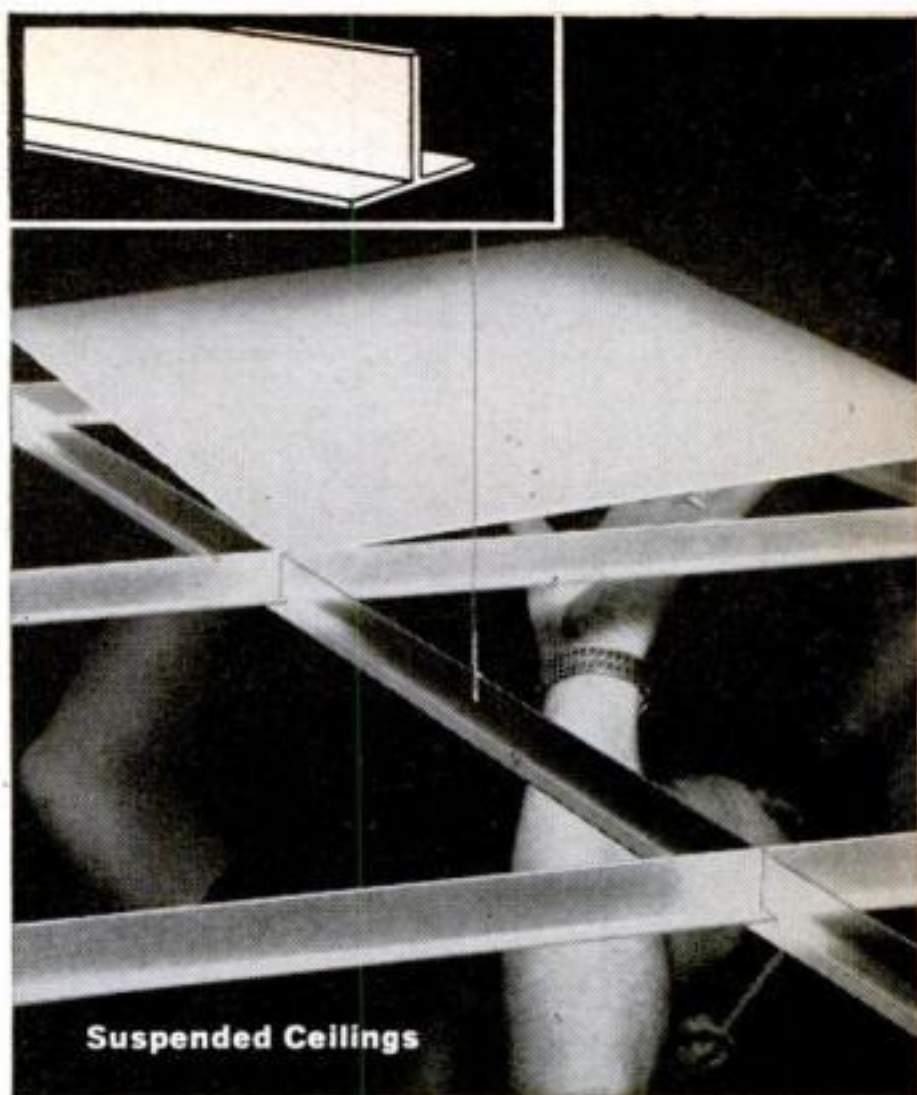
Specialized scooters. A rapidly growing class of tiny racing scooters is the latest result of the two-wheel craze. The machines are rather stark as far as equipment goes, but their frames are simple and rugged, similar to the four-wheeled racing karts from which they evolved. Popularly known as mini-bikes, they have potent engines, low overall drive ratios, and tough brakes to control the high speeds they are capable of reaching. Another similar competition machine is the hill-climb scooter. This has relatively high power, too, but a much different gear ratio—and not much else.

Because these machines are special-purpose outfits that appeal to a limited number of people, they are not represented in the accompanying specifications table. Nor are the special mountain-climbing models, offered by a few manufacturers, listed. These, needless to say, have very high drive ratios and husky engines, and are intended to carry a rider and several hundred pounds of camping equipment up steep grades and over rough ground.

Ultra-lightweight scooters are carried by many plane pilots so they won't have to depend on local transportation from the airport into town. At least one make of scooter is intended expressly for such use and folds up into an amazingly small package. It can be carried in fairly small boats as well.

As if these vehicles aren't economical enough, several makers are now offering super-bargain models—scooter kits that you can put together without machining or welding.

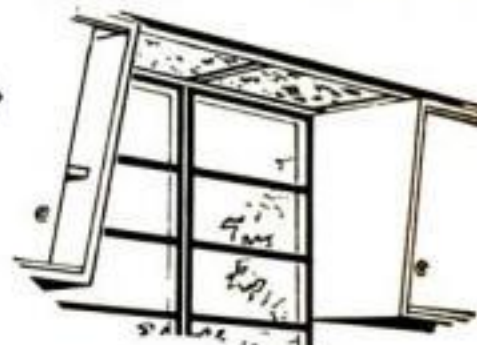
It all adds up to the cheapest way of traveling—short of walking. ■ ■



Suspended Ceilings

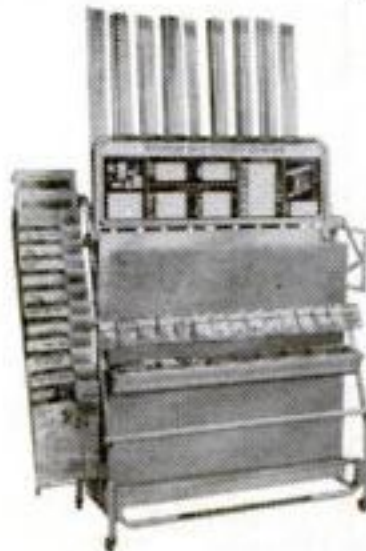
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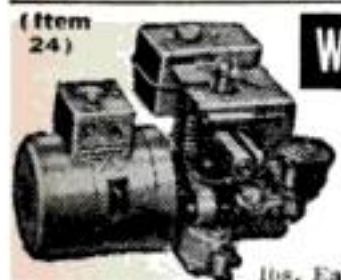
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The Faceless Army

[Continued from page 59]

and receiving Morse code. The same level of accomplishment goes for the other specialties.

After he has been trained as a specialist and cross-trained in three other skills, what then?

From arctic to jungle. Then he packs his duffel bags and goes off: to Alaska (for arctic training), to Panama (for jungle training), to Pisgah National Forest, N. C. (for mountain climbing), to Little Neck, Va. (for amphibious training with the Navy, learning how to sneak out of a submarine on a dark night and row to shore in a rubber boat), to Key West (for underwater demolitions), to Utah (for ski training).

Now the Special Forces man is almost ready for operations. His final training prepares him and his detachment for a specific country. He participates in an "area study" of the country, and learns the rudiments of its language.

The area study teaches him something of the country's geography, history, economics, politics, religions. He learns about the country's ethnic composition. Do the people in the north speak the same language as those in the south, worship the same divinities, eat the same foods? He is briefed on social customs: In some places, a social error could lose a mission.

The language of war. He is given 12 weeks to learn a basic vocabulary of 800-850 words—enough to communicate simple thoughts. What if he gets stuck while he is teaching, either because he does not know an expression, or the expression—say "trigger housing group"—does not exist? Special Forces has a smart dodge here. He will teach his students the *English* word for the object.

And he will use his hands. "Expressive hands," says a Special Forces officer, "are easily worth a few hundred words of vocabulary."

During those final weeks, also, he puts the polish on his guerrilla education. He studies textbooks on guerrilla warfare: by Mao Tse-tung, the leader of Red China; by Ernesto Guevara, Fidel Castro's lieutenant; by T. E. Lawrence, Britain's famous World War I guerrilla leader in Arabia.

Now he is ready to put into effect the

U.S. Special Forces: The Faceless Army

mathematics of guerrilla warfare. One A Detachment, Special Forces experts say, can train as many as 1,500 guerrillas. Well-trained and well-supplied guerrillas can tie down as many as 10-15 times their own number.

Does that mean that one A Detachment could tie down 15-22,000 men—a whole division? Says shrewd Mao Tse-tung: "Guerrillas are like fish, and the people are the water in which the fish swim. If the temperature of the water is right, the fish multiply and flourish."

In Cuba, a few fish multiplied into enough to win a country.

Ahead lies an arduous and dangerous campaign. In the textbooks, the stages sound simple: psychological preparation, initial contact, infiltration, organization of guerrilla forces—finally, combat.

This is the program ahead. In the meantime, the Special Forces man is training hard. Among the maxims he will study is Mao Tse-tung's famous dictum: "Guerrillas should be as cautious as virgins." ■ ■

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They'll Grow TV Sets Like Tomatoes

[Continued from page 89]

For other functions, you don't rearrange the radio block. You grow a different block to suit the new function. A TV block, for instance, would have to handle more complicated currents, at higher frequencies, and deliver two outputs (sound and picture).

Arranging atoms. The making of solid function blocks is a triumph of molecular engineering, closer to chemistry than electronics. The designer cannot sketch a circuit made up of old-fashioned components. He computes the flow of electricity through the block, figuring what changes—in voltage, current, frequency, and so on—must be accomplished to perform the job. Then he must arrange atoms and molecules within the block in such a way that they will accomplish those changes.

Manufacturing function blocks is a sort of synthetic agriculture. The trade jargon borrows farmers' words. The process starts with a seed, a small but perfectly formed crystal of the purest silicon ever known. The seed is dipped into a pot of molten silicon, then—under the most precise control—pulled out. The seed grows into a big, perfect crystal as atoms from the melt freeze onto it in exactly the right places.

New crystal-pulling techniques grow "dendrites"—very thin and narrow, absolutely perfect, and almost as long as you want. These ribbons are just sliced up for use.

A pure crystal is useless; it won't even conduct electricity let alone perform a radio job.

It must be carefully doped: purposely dirtied with just the right amount of impurity (a few atoms per million crystal atoms) in exactly the right places within the crystal. A mistake of millionths of an inch wrecks everything.

This can be done while the crystal is being grown. Impurity pills are dropped into the melt, like fertilizer in a furrow, to introduce the essential ingredients in the right places. Ultimately, complete radio or TV blocks might be grown this way, coming out of the pot all ready to be sliced off, slipped into cabinets, and plugged in. Today only a few simple function blocks grow from the melt in their final form. Most require treatment

They'll Grow TV Sets Like Tomatoes after the crystal is grown. Impurity layers are put into the crystal by elaborate alloying, diffusion, and etching techniques.

These processes are delicate. Today it is difficult to produce a whole batch to meet specifications. Only simple types have been made—single-purpose blocks such as amplifiers. No one has yet been able to combine several different functions into one block, as you would have to do for a solid-block radio or TV. (Some doubting Thomases think that won't be managed for a long, long time, if ever.)

And the units are still expensive. Officers at Wright Air Development Division like to show off the "Air Force jewels"—a plush-lined leather case containing the first function blocks, which cost the Government far more than diamonds.

Yet the spectacular success that has been achieved suggests an even more remarkable future. Why stop with integrating the inner electrical works into one solid block? Why not go on from there and make the whole thing, front to back, a single unit?

Self-powered? Batteries or power cords would not be needed. Semiconductor crystals, doped the right way, will generate electricity from other energy (heat, light, or a hard squeeze). So function blocks could be their own power sources, making automatically all the juice they'd need to operate.

Radios need loudspeakers to convert electricity into sound. But some crystals (piezoelectric types, like those in a phonograph pickup) can do that, too. Such a crystal might be amalgamated into the radio function block.

TV sets need picture tubes to convert electricity into light. Solid crystals to do that job are apparently just around the corner; eventually one might become the front surface of a television function block.

Such gadgets would be the ultimate in electronics: complete, self-contained "things," like apples or tomatoes. Lacking wires, batteries, identifiable parts, their electrical nature would disappear. Electrons jumping around inside their molecules would still make them work—basically the same thing that goes on inside apples and tomatoes. ■ ■

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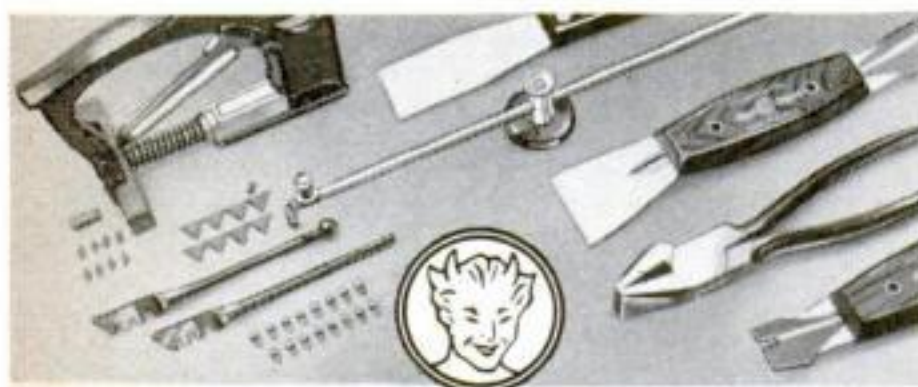
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Dehumidify . . . to Control Moist Air

[Continued from page 143]

erant type is, in fact, mechanically incapable of producing a relative humidity of much below 50 percent. At this point, the coils become so cold that the water on them freezes solid and no further dehumidification takes place.

Adsorption-type dehumidifiers, having no cooling coils, can keep on removing moisture down to as low as 20 or 30 percent regardless of temperature. This is important to keep in mind if you plan to use a dehumidifier in a cool basement or during the spring and fall when there may be plenty of dampness but not much heat. Humidities of 40 to 50 percent are often required to prevent rust and other harmful condensation. In this case, the adsorption type is a better bet than the refrigerant type. It's also automatic—there's no drip pan to empty.

Capacities are important. Dehumidifying a home is like trying to bail out the ocean—the water rushes right back in. For this reason, most dehumidifier capacities are based on a tightly enclosed space. If you open a door or window, don't expect much. In basements, it's even recommended that porous walls be painted to seal out moisture or the dehumidifier won't be able to function at full capacity.

Dehumidifiers—unlike humidifiers—are not designed for whole-house operation. Most machines will handle a space of 10,000 to 16,000 cubic feet—that's about one floor in the average home. If the area you want to dehumidify is larger, you'll need additional units.

What to look for. The actual amount of moisture that a machine will remove is the important thing to check. This ranges from two to eight gallons a day, with an average of three to four gallons for most models. In most cases, these are maximum figures, usually based on a temperature of 90 degrees and a humidity of 90 percent. Any machine, even the feeblest one, will take a lot of moisture out of the air when there's a lot in the air. Actually, there are few summer days when the humidity hits 90 percent. It's what a machine will do under average operating conditions that separates the men from the boys.

Test conditions set up by NEMA (National Electrical Manufacturers Asso-

Dehumidify . . . to Control Moist Air ciation and by ASRE (American Society of Refrigerating Engineers) specify 59 or 60 percent humidity—not 90. At this level, many machines remove only a half to three-quarters of their rated capacity. Some makers will reveal these test figures; many won't.

Watch out, too, for glib claims that say, "Just turn the humidistat to any desired setting from 80 to 20 percent humidity." What they mean is that the *humidistat* will go down to 20 percent—the machine won't. This is like owning a car with a speedometer that goes up to 300 m.p.h.—so what?

In refrigerant-type units, the compressor rating is also a helpful—though not completely reliable—indication of quality. Most low-priced models have compressors of $\frac{1}{8}$ or $\frac{1}{6}$ horsepower. Higher-priced—and higher-capacity—units generally have $\frac{1}{5}$ - or $\frac{1}{4}$ -hp. compressors. A few machines have good capacity despite a small compressor—a point to check carefully when you shop.

How about air conditioners? Air conditioners are often sold as substitutes for dehumidifiers. The fact is, they can be a blessing but not necessarily a cure-all. In the process of cooling the air, they do remove a great deal of moisture. But because they leave the air cool, the *relative* humidity may stay about the same.

This is no problem on hot, sunny days—then an air conditioner can actually outdo a dehumidifier. But on cloudy, humid days, or when a room is kept unusually cool, you may experience that familiar "cold, clammy" feeling—too much moisture in the air. You may sweat while feeling chilly. In extreme cases, you may even need a separate dehumidifier to get rid of the moisture that the air conditioner can't.

A few new air conditioners, such as Carrier, Mueller Climatrol, and Sears' Coldspot, have a built-in provision for dehumidifying without cooling. This is done by channeling the hot exhaust air back into the room instead of expelling it outdoors. The room air then remains warm but carries much less moisture. Some portable air conditioners can be used the same way by simply removing them from the window so they exhaust heat into the room. This way, you get dehumidification without cooling. ■ ■



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REGULAR—OIL SPRAY—ELECTRIC MOTOR

1,500-M.P.H. Family Cars?

[Continued from page 69]

by a pumping station, very likely nuclear-powered. These "people pipes" could be any length. They could be laid on the ocean floor from the American mainland to Hawaii, across the Bering Sea to the U.S.S.R., from New York to Europe. It should be possible to drive around the world some day.

Aeromobiles open up yet another approach to traffic problems. The idea of hands-off driving has titillated inventors ever since the curved-dash runabout. Many patents have been issued on automobile guidance systems using buried cables, radar, or other devices for steering a car automatically. All are expensive and fraught with maintenance and other troubles.

The guidance system. The Aeromobile is the only simple, safe, and economical vehicle for completely automatic operation. The inherent guidance of the groove offers reliable automation. The decision points need only be at junctions and turn-offs, and only there would electronic gear be located. A black box in the car could be preset to follow a route through the signals emitted by junction points. A punched tape—perhaps obtained from the auto club—would guide the car from coast to coast with a sleeping or reading driver. The car would move from low-to high-speed lanes automatically and remain in high-speed lanes until coded signals from the junctions told it to move down for turn off. This process could be repeated indefinitely until the car left the automatic system.

The GEM has the mobility of the helicopter. It moves forward, backward, sideways; permits pivot turns in a driveway and parallel parking by moving sideways.

Automated GEMs will even solve the galling parking problem. The driver could go downtown, get out at the office, and simply send the car home. The owner's garage becomes his private parking place. With the high speeds and economical mileage of GEM transport, it would be cheaper to send a car home "deadhead" than to park it. Suburban travel is often 20 to 30 miles—only minutes of groove travel. To return home, the owner might call his driverless car to come and pick him up—by dialing an electronic code on the telephone.

Shock Absorbers Are Getting Smarter

[Continued from page 107]

shaped space surrounding the cylinder, and this is the part attached to the wheels. On a rough road, the shock "can" is like a tireless cocktail shaker, whipping air into the fluid.

New approaches. Most makers now put baffles in the reservoir to reduce fluid agitation. Delco makes a premium-priced shock, used on Cadillacs, that eliminates all air from the reservoir. They use a bag made of nylon film and filled with Freon gas in the reservoir to allow for fluid expansion. Their experience with this unit suggests that fluid aeration, even under normal conditions, may be more troublesome than commonly thought. They are able to get adequate wheel control with lighter valving.

Columbus shock absorbers tackle the problem by inverting the whole shock. The reservoir is above the working cylinder, and this is the part attached to the car body. The fluid containers get the same smooth ride as the passengers and are not subjected to violent agitation by wheel movements.

Shock-absorber engineers are finding new jobs for shocks, as well as ways for them to do their old jobs better. The hydraulic cutoff shock is eliminating the rubber suspension bumpers on several cars this year. The fluid flow in these shocks is gradually cut off near the end of the stroke to bring the wheel to a controlled stop. It saves suspension clearance as well as avoiding the bounce you'd get from rubber bumpers.

Another development would let the driver control shock characteristics. With this system, you'd dial the firmness you wanted from front or rear shocks. Two knobs on the dash would let you choose extra firmness for high-speed turnpike driving, or switch to softer control for maximum comfort in city driving. The system has been tested successfully; all that's holding it up is the price tag.

Still in the labs is a position-sensitive shock. The idea here is to be able to vary the amount of control with the position of the wheel during its up-and-down travel. The general design approach is to use a metering rod that varies the size of a controlling orifice depending on the position of the piston in the cylinder.



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Ventilate to Remove Moisture

[Continued from page 140]

For proper crawl-space ventilation, the FHA requires at least one square foot of opening for every 15 feet around the enclosed space. This should be divided among four openings, one near each corner, placed as high in the foundation wall as possible.

This is for a dirt-floor crawl space. Pave it, or lay down a ground cover, and you can cut ventilation nearly 90 percent.

The moisture problem in crawl spaces is likely to be most severe in the fall when the earth is still warmer than the air or the house. Water evaporates from the ground, condenses on the floor above, and may even rise to the roof. If foundation vents are your only means of controlling crawl-space condensation, keep them open and unobstructed all year. If the floor becomes too cold, you may need insulation—but it's a lot cheaper than replacing a rotten floor.

Venting the stud spaces. In some cases, condensation inside hollow walls becomes so severe that it's necessary to vent the walls themselves to let trapped moisture escape before it condenses. This is done by piercing each stud space.

This type of venting is valuable where an impermeable material has been used in the outer wall, preventing the escape of vapor. It's less effective where the wall is packed with insulation, and some experts question the whole practice. Vapor can condense before reaching the vents, they point out. At freezing temperatures, it may form frost and plug the vents.

At best, such venting is no substitute for a vapor barrier to keep moisture out of walls. And it's a tedious job, since you must pierce every full-length stud space, top and bottom, as well as every short one caused by windows and doors or fire stops. The holes should be 3/4" or 1" in diameter, and you can insert tiny louvers made for this purpose.

Summer ventilation can backfire. In summer, ventilation may make a house damp. If, due to an abrupt weather change, interior surfaces become colder than the humid outside air, condensation will result. This is often the cause of mildew, and explains why basement condensation is more of a problem in summer than winter. The solution, in areas of high humidity, is a dehumidifier. ■ ■

Answers to PS Puzzlers on 16 and 18

Greek cross. Problem 1 is fairly easy:

Problem 2: Observe that the total area of the cross, if each side is x , is $5x^2$. This means that the side of the square to be formed must be exactly $x\sqrt{5}$. Now the cross is loaded with lines that are exactly $x\sqrt{5}$ units long—so that's your clue. The stipulation that you find four congruent pieces (same size and shape) suggests sliding a length of $x\sqrt{5}$ and one perpendicular to it so that the intersection is exactly in the center of the cross. The result shows a swastika pattern.

Problem 3: Slide the perpendiculars to a point at the edge of the figure.

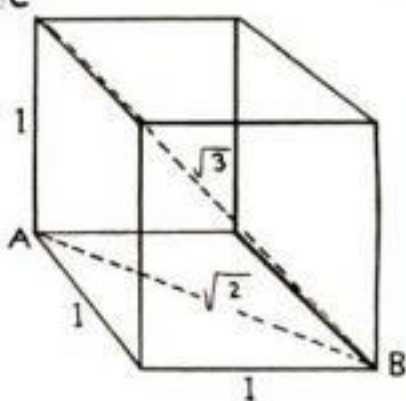
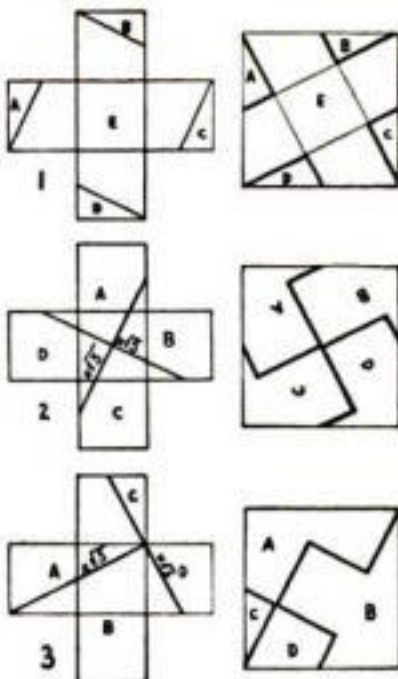
Koko: He juggles them. That way two are always in the air.

Cross: Fold down a corner of the paper:

Knot in string: Cross your arms first, then pick up the ends of the string and pull them through. As your arms unknot, the string knots.

Division code. The product of b times b ends in b . Therefore b is 1, 5, or 6. It's not 1 because the multiplication yields a three-digit figure. Looking at the next step we see $e - h = e$. Therefore $h = 0$, and f times b is a number ending in 0. If $b = 5$, f can be 2, 4, 6 or 8. If $b = 6$, f would be 5. Now observe that at the second subtraction $g - c = c$. Therefore $g = 2c$. This implies that f is a number bigger than b . So b can't be 6. So $b = 5$ and f is either 6 or 8. The rest is trial and error: You look for the number (25, 35, 45, etc.) that, when multiplied by 6 or 8, yields a number whose first digit is twice the second. 35 times 6 is the only one. (The result is 210.) Therefore the original problem must have been $35 \overline{)19,775} = 565$.

Long gun. Pack the gun along the main diagonal of a box exactly a yard by a yard by a yard. The base diagonal is $\sqrt{2}$ yards long. (By the Pythagorean Theorem, $AB^2 = 1^2 + 1^2 = 2$ so $AB = \sqrt{2}$.) That side along with one of the vertical edges form the legs of another right triangle whose hypotenuse is the main diagonal of the box. Thus we have $BC^2 = 1^2 + \sqrt{2}^2 = 3$. So $BC = 1.73 +$.



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World's Fastest Bomber

[Continued from page 74]

houses. Electricity for the plane's great needs is generated by three 40-kw. alternators on engines 1, 2, and 3. They produce enough current to serve a community of 300 homes.

Of the B-58's astonishing bombing-and-navigation system, one engineer has said that it is about as easy to operate as an automatic washing machine.

The know-it-all system. At the start of a mission, the bombardier-navigator feeds the system's computer the essential information about where he wants the plane to go and what route he wishes it to take. The system is then capable of guiding the plane precisely according to those taped commands. Its computer collects continuous readings from an array of instruments, including a radio altimeter, Doppler radar, search radar, automatic star-tracker, and astrocompass, and compares them with preset instructions.

The system knows constantly whether or not the plane is on course, and if not, what change is needed. It conveys this information to the operator on counters, like an odometer's, set in tiny windows here and there on the panel he faces.

It tells the bombardier-navigator the plane's position, heading, track, air speed, ground speed, distance to target, and any other navigational facts he needs to know, as often as he wants them. He can get a complete rundown once a minute if he likes.

Meanwhile, a tape is automatically making a complete log of the trip.

The system is accurate enough, even after hours of flight, to startle the most seasoned navigator, declares Air Force Capt. William L. Polhemus, a B-58 crewman who's an old hand with a sextant.

If the pilot is flying the plane manually, the bombardier-navigator can tell him over the intercom whenever the computer says a flight correction is necessary. On the other hand, if the computer is hooked up to the autopilot, as it can be, it corrects the plane's position without human help. At the proper instant, it can even aim and release the bomb.

Birth of the B-58. The unique B-58 has been in service less than a year. It evolved from a scheme to carry a midget fighter under the belly of the mammoth B-36, biggest operational bomber ever

built. That scheme was abandoned when the 36 was replaced by the smaller, faster B-52, which is still SAC's mainstay.

But out of this "parasite-fighter" idea grew plans for a much more remarkable plane—a bomber that would as far outrun that worthy workhorse, the B-52, as the B-52 outpaced the Wright Brothers' first plane.

This was the B-58. At first a secret concept with no name, at Convair's Fort Worth plant, it was one day being described with zest by Robert Widmer, chief engineer, to Stan Brown, another Convair official.

"From what you say," remarked Brown, "this plane is really going to hustle. Why not call it the Hustler?"

So it was christened, and so it performs.

Last January, the B-58 hustled its way to six official world speed records, with varying payloads. They were extraordinary marks, nearly twice as fast as the old ones. What made the triumph especially sweet for SAC was that five of the six previous records so overwhelmingly surpassed had been set by Russian planes.

One of the two B-58s in the trials averaged 1,284.73 m.p.h. over a closed course about equal to the distance between Washington, D. C., and Chicago. It hit a top speed of 1,430 m.p.h., burning off some of its paint in the process, and made the trip in 29 minutes.

For this feat, the plane and its crew won the Thompson Trophy, one of aviation's most valued awards. It was the first time in the 31-year history of the trophy that a heavy bomber copped it.

Bomber vs. missile. SAC now has two B-58 wings, filling a kind of intermediate role between planes and missiles. When one questions the usefulness even of supersonic bombers in a day when missiles are advancing rapidly, the SAC answer is firm and clear. The bomber has one supreme advantage over any missile: It can be recalled, in case the alarm that sent it winging was a mistake. It is superior in two other crucial ways: It can hunt for and find a target, in case knowledge about its location is not precise. And it can attack an alternate target, in case that should suddenly prove to be desirable. ■ ■

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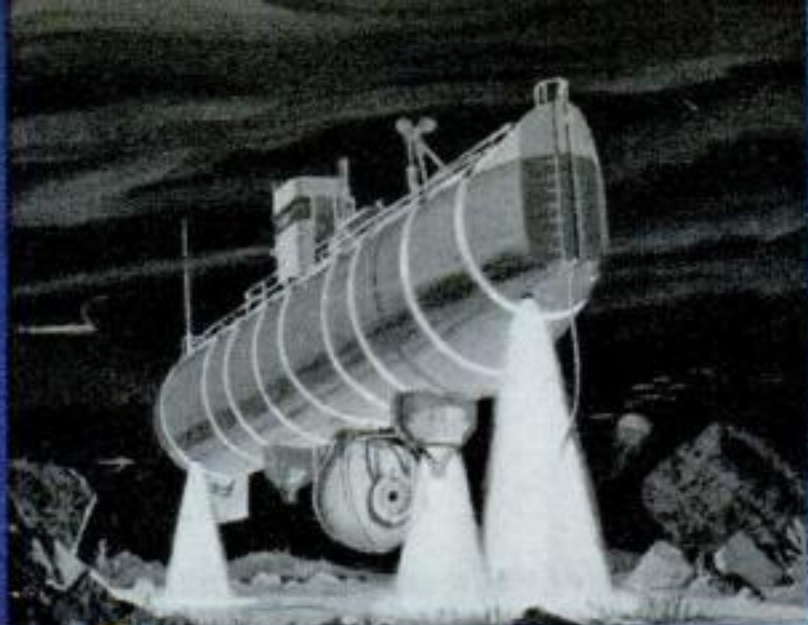
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